CHAPTER 3: AFFECTED ENVIRONMENT

3.1 Introduction

This chapter describes the environmental resources that may be affected by the proposed action or the alternatives. It is based primarily on the corresponding chapter in the FEIS for Bottomfish and Seamount Groundfish Fishery of the Western Pacific Region (WPRFMC 2005b), and has been updated to incorporate more recent information, including the 2003 fishery data made available in the Bottomfish FMP annual report (WPRFMC 2005c) and additional analyses conducted by PISFC staff.

The Bottomfish FMP (WPRFMC 1986), its amendments, and implementing regulations define fishery management area and sub-areas within the EEZ surrounding the State of Hawaii as follows. The inner boundary of the fishery management area is a line coterminous with the seaward boundaries of the State of Hawaii (i.e. the 3-mile limit). The outer boundary of the fishery management area is a line drawn in such a manner that each point on it is 200 nautical miles from the baseline from which the territorial sea is measured.

The federal bottomfish fishery management area in Hawaii is divided into three sub-areas (Figure 5) with the following designations and boundaries:

> (1) Main Hawaiian Islands (MHI) means the EEZ of the Hawaiian Islands Archipelago lying to the east of 161°20' W longitude.
>
> (2) Northwestern Hawaiian Islands (NWHI) means the EEZ of the Hawaiian Islands Archipelago lying to the west of 161°20' W Midway Island is treated as part of the Northwestern Hawaiian Islands Sub-area.
>
> > (i) Hoomalu Zone means that portion of the EEZ around the NWHI west of 165°W longitude.
> >
> > (ii) Mau Zone means that portion of the EEZ around the NWHI between 161°20' W longitude and 165° W longitude.
>
> (3) Hancock Seamount means that portion of the EEZ in the Northwestern Hawaiian Islands west of 180°00' W longitude and north of 28°00' N latitude.

As noted above, the proposed action will not affect the groundfish resources of the Hancock Seamount, and that sub-area will not be considered further in this EIS.

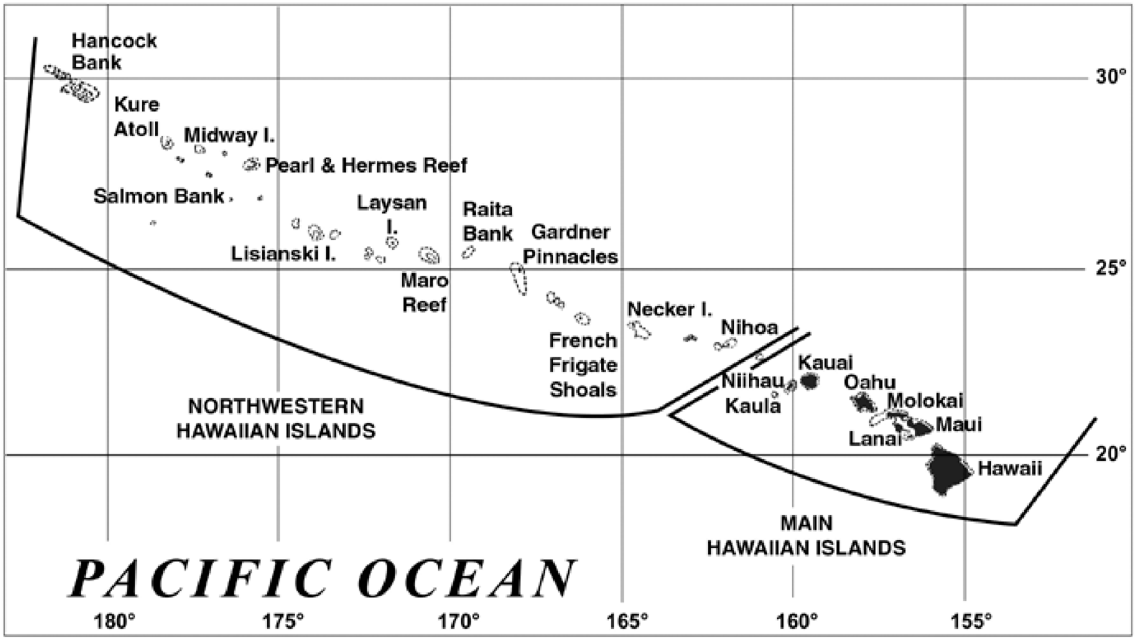


Figure 5: The Hawaii Archipelago.

3.2 Oceanographic Setting

The ocean is a three-dimensional medium stratified vertically in terms of light penetration, temperature, nutrient concentrations, and concentration of dissolved oxygen. Toward the surface is the photic zone, the waters that receive the sun’s light. In Hawaii, this zone extends as deep as about 100 meters. Surface waters are mixed by the wind creating a chemically homogeneous layer varying from about 120 meters deep in winter to perhaps 30 meters deep in summer. Below this mixed layer is a zone of rapidly decreasing temperature called the thermocline. Below the thermocline, temperature decreases gradually to the bottom. Primary production by phytoplankton and benthic macroalgae consumes nutrients in the photic zone, resulting in low ambient nutrient concentrations in the mixed layer. As organisms die and sink out of the photic zone and through the thermocline, decomposition produces inorganic nutrients while consuming oxygen. Thus, the surface mixed layer is low in nutrients but high in oxygen, while the reverse is true below the thermocline.

The BMUS occupy habitat within and below the photic zone and mixed layer, although the species of most concern, onaga and ehu, tend to occupy waters deeper than 150 meters. Typically, metabolic processes are slow in such deep waters with low oxygen concentrations. Top carnivores in this cold, dark, relatively low-energy environment tend be long-lived, with slow growth rates and delayed reproductive maturity. Such is generally the case for deep-slope bottomfish, which makes them more susceptible to overfishing.

3.2.1 Currents and Eddies

The depth of the thermocline (middle layer of the ocean where differences in water temperature inhibit mixing with surface layer) varies greatly over the ocean, setting up gradients in water density and pressure that result in large-scale water movements called geostrophic currents. In the North Pacific Ocean the geostrophic currents form a large, basin-scale, clockwise movement called the North Pacific Subtropical Gyre (NPSG), centered at about 28°N. At the latitude of Hawaii, circulation is roughly east to west, reinforcing the wind-driven surface currents. Between about 18°N and 22°N, the currents are strongly influenced by the islands. According to Juvic and Juvic (1998):

> The North Equatorial Current (NEC) forks at Hawai‘i Island; the northern branch becomes the North Hawaiian Ridge Current (NHRC) and intensifies near the islands with a typical width of 65 miles (100 km) and speed of 0.5 knots (25cm/s). West of the islands, two elongated circulations appear. A clockwise circulation is centered at 19°N, merging to the south with the southern branch of the NEC. A counterclockwise circulation is centered at 20°30’N. Between them is the narrow Hawaiian Lee Countercurrent (HLCC), extending in longitude from 170°W to 158°W. Surface currents over the western islands and northeast of the NHRC are variable, and their average is smaller than can be estimated from existing data.

Within the NPSG, the westward flowing northern edge of NEC grazes the Hawaiian Islands, mainly near the Big Island. The NHRC can be thought of as a small part of the NEC that turns northwest to flow along the windward side of the chain instead of turning southwest to pass south of Hawaii Island (E. Firing, UH-SOEST, personal communication). Ten years of shipboard acoustic Doppler current profiler data collected by the NOAA shows a mean westward flow of the NHRC through the ridge between Oahu and Nihoa, and extending along the lee side of Nihoa and Necker to depths from 20 to 250 m (Firing 2006).

The Subtropical Counter Current (STCC) is an eastward flowing surface current found typically along 24°N from 130°E to 160°W. The eastward flowing HLCC is generally located along 20°N and extends from about 150°E to just west of the Hawaiian Islands (Kobashi and Kawamura 2002). The formations of the STCC and HLCC have recently been attributed to the “wake effect” that results from the combination of the westward trades winds blowing over the Hawaiian Archipelago.[8]

Generally within the lee of the archipelago there are an abundance of mesoscale eddies created from a mixture of wind, current, and sea floor interactions. The eddies, which can rotate either clockwise or counter clockwise, have important biological impacts, and likely play an important role in larval transport (E. Firing, UH-SOEST, personal communication). Eddies create vertical fluxes, with regions of divergence (upwelling) where the thermocline shoals and deep nutrients are pumped into surface waters enhancing phytoplankton production, and also regions of convergence (downwelling) where the thermocline deepens.

[8] http://science.nasa.gov/headlines/y2002/10apr_hawaii.htm

3.2.2 Productivity Trends

Most oceanic food webs (excluding, for example, those around volcanic vents) depend on primary producers (phytoplankton and macroalgae) to convert inorganic nutrients and the sun's energy into organic compounds that are then consumed and incorporated at successively higher trophic levels. Growth rates of primary producers may be limited by the availability of light or the lack of essential nutrients. Most often in the sea, the limiting factor is the availability of nitrogen. A deep and strong thermocline is an effective barrier to the transport of inorganic nitrogen to surface waters. Climatological cycles, winds and currents, as noted above, can greatly affect the depth of the thermocline and the rate of nutrient recharge. These events and cycles may be quite transitory, with annual or longer duration, such as the El Niño–Southern Oscillation, or even longer. For example, Polovina et al. (1994) showed that decadal-scale climate changes resulted in changes in the mixed layer depth and ultimately changes in productivity of the entire ecosystem in the North Pacific Ocean. Productivity changes at all trophic levels in the NWHI varied by 30–50 percent as a result of this documented decadal-scale climate cycle. Thus, it is important to understand that the "carrying capacity" of the environment, or potential productivity of an ecosystem, is dynamic and may fluctuate considerably in response to oceanographic conditions as mediated by climatological cycles and events. In terms of bottomfish resources, these cycles may be expressed as variability in stock size, recruitment, growth rates, or other factors.

3.3 Hawaii's Deep-Water Bottomfish

3.3.1 Habitat Requirements

Commercially important deepwater bottomfish inhabit the deep slopes of island coasts and banks at depths of 100 to 400 meters. The distribution of adult bottomfish in the region is correlated with suitable physical habitat. Because of the volcanic nature of the islands within the region, most bottomfish habitat consists of steep-slope areas on the margins of the islands and banks. The habitat of the six most important bottomfish species tend to overlap to some degree, as indicated by the depth range where they are caught. Within the overall depth range, however, individual species are more common at specific depths. Depth alone, however, may not indicate satisfactory habitat, and both the quantity and quality of habitat at depth are important. Bottomfish are typically distributed in a nonrandom patchy or contagious pattern, reflecting bottom topography and oceanographic conditions. Much of the habitat within the depths of occurrence of bottomfish is a mosaic of sandy low-relief areas and rocky high-relief areas. An important component of the habitat for many bottomfish species appears to be the association of high-relief areas with water movement. In the Hawaiian Islands and at Johnston Atoll, bottomfish density has been shown to be correlated with areas of high relief and current flow (Haight 1989; Haight et al. 1993a; Ralston et al. 1986). Although the water depths utilized by bottomfish may overlap somewhat, the available resources may be partitioned by species-specific behavioral differences. In a study of the feeding habitats of the commercial bottomfish in the Hawaiian Archipelago, Haight et al. (1993b) found that ecological competition between bottomfish species appears to be minimized through species-specific habitat utilization. Species may partition the resource through depth and time of feeding activity, and through different prey preferences. Although deepwater snappers are generally thought of as top-level carnivores, several snapper species in the Pacific are known to incorporate significant amounts of zooplankton in their diets (Haight et al. 1993b).

Cooperative studies by the State of Hawaii’s Department of Land and Natural Resources, the University of Hawaii, and NOAA, using submersible and remotely operated vehicles, are investigating, among other things, bottomfish habitat. Results indicate that the preferred habitat for the snapper species consists of hard substrate with a relatively large number of holes and crevices that serve as shelter for smaller fish and shrimp that onaga and ehu are presumed to feed on. In pinnacle habitats in particular, the abundance of small fish and invertebrates is similar to, if not greater than, that observed on shallow water coral reef habitats. Onaga and ehu, as well as their potential prey species, were found to be absent over sand substrates as well as hard substrates with few holes. The presence of one species of potential prey fish, longtailed slopefish (*Symphysanodon maunaloae),* appears to be highly correlated with the presence of ehu and onaga. Several potential competitor species have also been also observed in these habitats including the hogo (*Pontinus macrocephalus*), moray eels (*Gymnothorax berndti* and *G. nuttingi*), kalekale (*Pristipomoides sieboldii*), and the hapu‘upu‘u (*Epinephelus quernus*). Juvenile onaga and ehu were found in an area of small, low carbonate (limestone) features scattered over an otherwise sandy bottom. Unlike juvenile ōpakapaka, which have been found to occupy shallower depths than adults, juvenile onaga and ehu were found at the same depths as adults.

3.3.1.1 Essential Fish Habitat and Habitat Areas of Particular Concern

The MSA identifies essential fish habitat (EFH) as those waters and substrate necessary to fish for spawning, breeding, feeding, and growth to maturity. This includes the marine areas and their chemical and biological properties that are utilized by the organism. Substrate includes sediment, hard bottom, and other structural relief underlying the water column along with their associated biological communities. As part of Amendment 6 to the Bottomfish FMP, the Council designated EFH for bottomfish MUS which were approved by NMFS in 1999 (64 FR 19068; April 19, 1999).

In addition to and as a subset of EFH, the Council described habitat areas of particular concern (HAPC) based on the following criteria: ecological function of the habitat is important, habitat is sensitive to anthropogenic degradation, development activities are or will stress the habitat, or the habitat type is rare.

In considering the potential impacts of a proposed action on EFH, all designated EFH must be considered. Thus, the designated areas of EFH and HAPC for all Council FMPs are shown in Table 5.

Table 5: Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC) for all Western Pacific FMPs.

FMP	EFH (Juveniles and Adults)	EFH (Eggs and Larvae)	HAPC
Pelagics	Water column down to 1,000 meters	Water column down to 200 meters	Water column above seamounts and banks down to 1,000 meters
Bottomfish and Seamount Groundfish	**Bottomfish:** Water column and bottom habitat down to a depth of 400 meters Seamount groundfish: (adults only) water column and bottom from 80 to 600 meters	**Bottomfish:** Water column down to a depth of 400 meters Seamount groundfish: (including juveniles) epipelagic zone (0 to 200 nm offshore)	**Bottomfish:** All escarpments and slopes between 40–280 meters, and three known areas of juvenile ōpakapaka habitat Seamount groundfish: not identified
Precious Corals	Keahole Point, Makapuu, Kaena Point, Westpac, Brooks Bank, 180 Fathom Bank deep-water precious coral (gold and red) beds, and Milolii, Auau Channel, and S. Kauai black coral beds	NA	Makapuu, Westpac, and Brooks Bank deep-water precious corals beds and the Auau Channel black coral bed
Crustaceans	Bottom habitat from shoreline to a depth of 100 meters	Water column down to 150 meters	All banks within the NWHI with summits less than 30 meters
Coral Reef Ecosystems	Water column and benthic substrate to a depth of 100 meters	Water column and benthic substrate to a depth of 100 meters	All MPAs identified in FMP, all PRIAs, many specific areas of coral reef habitat (see FMP)

All areas are bounded by the shoreline and the outer boundary of the EEZ, unless otherwise indicated. Source: Amendment 6 to the Bottomfish FMP.

3.3.2 Management Unit Species (MUS)

3.3.2.1 Bottomfish Management Unit Species (BMUS)

The bottomfish fisheries in the region target an assemblage of species from the taxonomic groups: Lutjanidae (snappers), Serranidae (groupers), Carangidae (jacks), and Lethrinidae (emperors). Table 6 presents the list of BMUS designated under the Bottomfish FMP.

Table 6: List of Bottomfish Management Unit Species (BMUS).

Common name	Local Name	Scientific Name
Snappers		
Silver jaw jobfish	*Lehi* (H); *palu-gustusilvia* (S)	*Aphareus rutilans*
Grey jobfish	*Uku* (H); *asoama* (S)	*Aprion virescens*
Squirrelfish snapper	*Ehu* (H); *palu-malau* (S)	*Etelis carbunculus*
Longtail snapper	*Onaga*, *ulạula* (H); *palu-loa* (S)	*Etelis coruscans*
Blue stripe snapper	*Tạape* (H); *savane* (S); *funai* (G)	*Lutjanus kasmira*
Yellowtail snapper	Yellowtail, *kalekale* (H); *Palu-ị Iusama* (S)	*Pristipomoides auricilla*
Pink snapper	*Opakapaka* (H); *palu-tlena lena* (S); *gadao* (G)	*Pristipomoides filamentosus*
Yelloweye snapper	Yelloweye *ōpakapaka*, *kalekale* (H); *Palusina* (S)	*Pristipomoides flavipinnis*
Snapper	*Kalekale* (H)	*Pristipomoides sieboldii*
Snapper	*Gindai* (H,G); *palu-sega* (S)	*Pristipomoides zonatus*
Jacks		
Giant trevally	White *ulua* (H); *tarakito* (G); *sapo-anae* (S)	*Caranx ignoblis*
Black jack	Black *ulua* (H); *tarakito* (G); *tafauli* (S)	*Caranx lugubris*
Thick lipped trevally	*Pig ulua*, *butaguchi* (H)	*Pseudocaranx dentex*
Amberjack	*Kahala*	*Serioila dumerili*
Groupers		
Blacktip grouper	*Fausi* (S); *gadau* (G)	*Epinephelus fasciatus*
Sea bass	*Hapụupụu* (H)	*Epinephelus quernus*
Lunartail grouper	*Papa* (S)	*Variola louti*
Emperors		

Common name	Local Name	Scientific Name
Ambon emperor	*Filoa-gutumumu* (S)	*Lethrinus amboinensis*
Redgill emperor	*Filoa-pạlọomumu* (S); *mafuti* (G)	*Lethrinus rubrioperculatus*
Seamount groundfish		
Alfonsin		*Beryx splendens*
Ratfish/butterfish		*Hyperoglyphe japonica*
Armorhead		*Pseudopentaceros richardsoni*

Note: G = Guam; H = Hawaii; S = American Samoa.

Relatively little is known about the reproduction and early life history of deepwater bottomfish in the region. Spawning occurs over a protracted period, and peaks from July to September (Haight et al. 1993b). The eggs are released directly into the water column. The eggs hatch in three to four days, and the planktonic larval phase is thought to last at least 25 days (Leis 1987). For some species this phase may be considerably longer. For example, the pelagic stage for ‘ōpakapaka is believed to be as long as six months (Moffit and Parrish 1996). Experimental work at the Hawaii Institute of Marine Biology found that ‘ōpakapaka eggs incubated at temperatures characteristic of adult habitat did not hatch, but those incubated in water at surface temperatures hatched and were reared for up to 4 months (C. Kelly, HURL, personal communication). This indicates that surface currents or eddies could play an integral role in the dispersal of some bottomfish larvae.

Larval advection simulation research indicates that larval exchange may occur throughout the Hawaiian archipelago and that the amount of larval exchange between the NWHI and the MHI is correlated with the duration of the larval phase, with the highest larval exchange occurring with the longest larval phase durations (Kobayashi 1998). The direction of larval exchange is subject to oceanographic circulation patterns as well as large-scale temperature or climate variation, leading to oceanographic regime shifts of different scales (e.g. El Niño, the Pacific Decadal Oscillation). Many such oceanographic events and their resultant impacts to marine ecosystems have been described, including impacts to Pacific pelagic species (Polovina et al. 2001) and other Pacific fisheries including the Hawaiian lobster fishery (Polovina 2005). Data on actual larval exchange rates between the MHI and NWHI are lacking. Preliminary research indicates that genetic connectivity does exist between MHI and NWHI bottomfish species.

Little is known of the life history of the juvenile fish after settling out of the plankton, but research on opakapaka (*P. filamentosus)* indicates the juveniles utilize nursery grounds well away from the adult habitat (Parrish 1989). Most of the target species have a relatively high age at maturity, long life span, and slow growth rate. These factors, combined with considerable variation in larval recruitment, make these species more susceptible to overfishing (Haight et al. 1993a).

3.3.2.2 The Deep 7 Species

Hawaii's bottomfish fisheries target bottomfish species and species complexes at characteristic depths. At shallow depths (surface to 40 fm) uku are fished while drifting or slowly trolling over relatively flat bottom. Deeper water species complexes (e.g. ōpakapaka at 40 to 120 fm; onaga at 80 to 150 fm) are found along high-relief, deep slopes and are fished with a different method, vertical handline. In 1998, the State of Hawaii established bottomfish management regulations focused on seven of these deep-water species, including onaga, ehu, kalekale, ōpakapaka, gindai, lehi, and hapụupụu. These are termed the "Deep 7." All but hapụupụu are snappers. The paragraphs below briefly summarize information regarding the Deep 7 species.

Onaga: Large specimens of onaga will reach at least 3 feet in length and weigh up to 30 pounds. They inhabit deep, rocky bottoms offshore and are known to occur between 80 and 250 fathoms. Onaga are commonly caught on or near the bottom, in areas of steep drop-offs, ledges, and pinnacles. Onaga feed on small fishes, squids, and crustaceans, and are thought to reach sexual maturity at about 21 inches and 5 pounds, at approximately 5 years old. Females with ripe ovaries have been reported during August and September. Onaga are distributed throughout the Indo–Pacific region.

Ehu: Adult ehu will reach a length of at least 24 inches and a weight of up to about 12 pounds. They inhabit deeper offshore water beyond the reef, mainly occurring over rocky bottoms, usually between 80 and 218 fathoms. They feed on fishes and larger invertebrates such as squids, shrimps, and crabs, and reach sexual maturity at about 11.7 inches fork length, or 1 pound in weight, at approximately 3 years old. Ehu are distributed throughout the Indo–Pacific region.

Kalekale: Large specimens of kalekale can reach up to 24 inches in length and 6 pounds. Commonly, they are found at around 12 inches in length. They inhabit deeper offshore water beyond the reef, occurring over rocky bottoms usually between 40 and 200 fathoms. They feed on fish, shrimps, crabs, polychaetes, cephalopods, and urochordates. Fish of 14 inches fork length are approximately 2 pounds in weight and 5 years old. Kalekale are distributed throughout the Indo–Pacific region.

Ōpakapaka: Large specimens will reach a length of at least 3 feet and weigh up to about 20 pounds, with a maximum known age of 18 years. They inhabit deeper offshore water beyond the reef, occurring over rocky bottoms, usually between 40 and 120 fathoms. Fish apparently migrate into shallower depths near 40 fathoms at night. They feed on small fishes, squids, shrimps, crabs, pyrosomes, and zooplankton. Sexual maturity is reached at about 1.8 years and they generally spawn at about 2.2 years (1.5 pounds, 13 inches fork length). In 1989, Henry Okamoto, Hawaii Division of Aquatic Resources, initiated a tagging study to evaluate the growth and movement of deep water species, particularly opakapaka. Between 1989 and 1994, 4240 opakapaka and other bottomfish were tagged using surgically placed anchor tags with stiff nylon streamers. Fishermen have since recaptured and reported 397 opakapaka between 1989 and 2003. The study suggests that opakapaka are able to move between islands, and cross channels, with water depths of 1400 fathoms or less. Inter-island crossing of opakapaka tagged and recaptured include fish that moved from Oahu to Molokai (22 nautical miles, depths exceeding

300 fathoms), Oahu to Kauai (60 nautical miles, depths exceeding 1,400 fathoms) and Maui to Big Island (27 nautical miles, depths exceeding 1,000 fathoms). Ōpakapaka are distributed throughout the Indo–Pacific region.

Gindai: Gindai will reach up to 20 inches in length and 6 pounds in weight. They inhabit deeper offshore water beyond the reef, occurring over rocky bottoms, usually between 60 and 130 fathoms. They feed on fishes, shrimps, crabs, cephalopods, and other invertebrates. Gindai are distributed throughout the Indo–Pacific region.

Lehi: Large lehi specimens will reach a length of at least 3 feet and weigh up to about 30 pounds. They inhabit reefs and rocky bottom areas usually between 60 and 100 fathoms. They feed on fish, squid, and crustaceans. Lehi are distributed throughout the Indo–Pacific region.

Hapụupụu: This grouper reaches lengths of up to 4 feet and weighs up to 60 pounds. They occur in waters 11 to 208 fathoms deep. They feed mainly on fish and crustaceans. The hapụupụ is endemic to the Hawaiian Islands and Johnston Island.

3.3.3 Status of the Stocks

3.3.3.1 Spawning Potential Ratio

Amendment 3 to the Bottomfish FMP defines recruitment overfishing as a condition in which the ratio of the spawning stock biomass per recruit at the current level of fishing, to the spawning stock biomass per recruit that would occur in the absence of fishing (termed spawning potential ratio, or SPR) is equal to or less than 20 percent. Given the scarcity of data, and using the best available information, the Council used to use SPR as a proxy for maximum sustainable yield (MSY). The 1996 reauthorization of the MSA by the Sustainable Fisheries Act (SFA) contained new requirements for monitoring potential overfishing, and added bycatch requirements among other things. In a supplement to Amendment 6 to the Bottomfish FMP, the Council established methods to comply with the SFA's overfishing provisions that allow calculation of MSY and other reference parameters (68 FR 16754; April 7, 2003). The details of the overfishing provisions are described in detail in this chapter. However, the Council has amassed 18 years of SPR data for Hawaii's bottomfish fisheries, and the values are useful to illustrate of the status of the bottomfish stocks in the three Hawaii management zones.

Fishery data for 2003 suggest that none of the five BMUS species for which SPR values can be calculated have SPR values below the 20 percent critical threshold that defines recruitment overfishing in the Bottomfish FMP. Estimated SPRs range from a low of 31 percent for onaga to a high of 50 percent for hapụupụu when expressed on an archipelago-wide basis. However, onaga and ehu stocks are severely stressed in the MHI. In 2003, the MHI SPR values for these species are below 20 percent (10.26 percent for onaga and 4.69 percent for ehu) using targeted CPUE figures (WPRFMC 2005c). The Council's Bottomfish Plan Team believes that targeted CPUE better represents the condition of bottomfish stocks in the MHI than aggregated CPUE. Using this measure, neither 'ōpakapaka nor uku SPRs indicate critically depleted conditions. Table 7 summarizes the archipelago-wide SPR values (using aggregate CPUE) for the most important BMUS, and Figure 6 shows these trends graphically.

Table 7: Historical Annual Archipelago-Wide SPRs (%) by BMUS Stock.

Year	Ehu	Hapụupụu	Onaga	Opakapaka	Uku
1986	41	55	53	51	58
1987	61	71	61	69	65
1988	37	56	42	49	62
1989	51	70	38	69	68
1990	44	57	36	57	52
1991	44	58	42	57	53
1992	51	67	41	68	61
1993	54	65	53	67	73
1994	38	51	39	53	52
1995	41	48	33	54	56
1996	43	49	39	52	57
1997	42	49	25	52	51
1998	38	44	22	47	50
1999	37	47	34	46	55
2000	39	49	27	52	52
2001	40	51	26	51	48
2002	37	45	26	47	45
2003	36	50	31	48	43
M	43.00	54.56	37.11	54.94	55.61
SD	6.93	8.52	10.67	7.94	7.86

Source: 2003 Bottomfish Annual Report, WPRFMC 2005c.

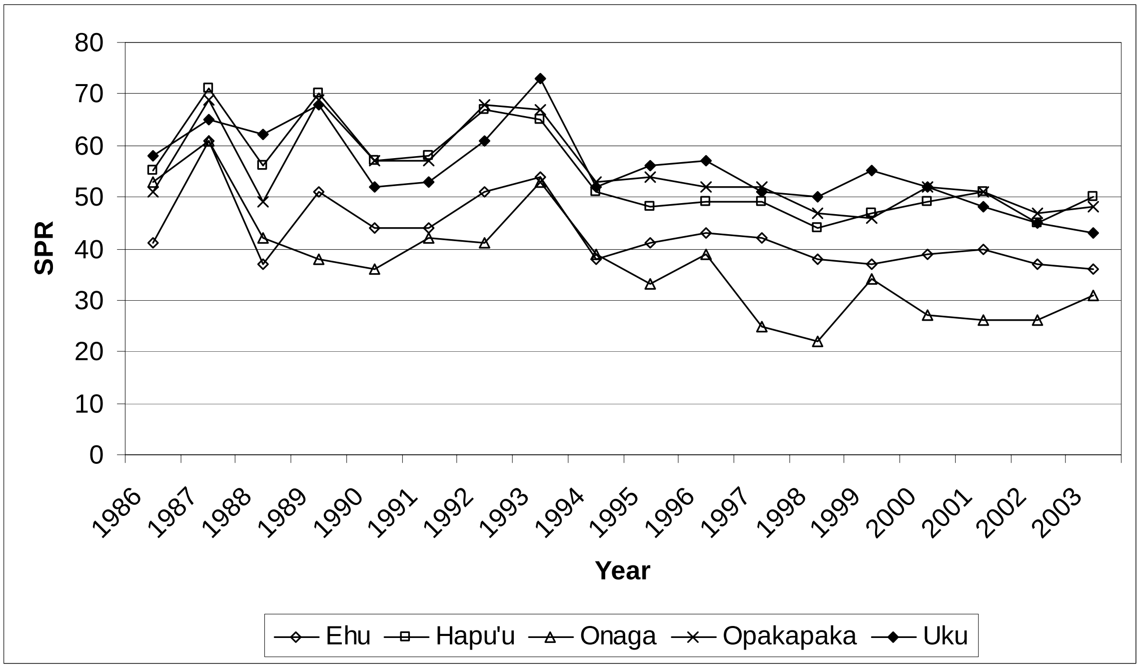


Figure 6: SPR Trends by BMUS Stock. Source: 2003 Bottomfish Annual Report, WPRMC 2005c.

While the bottomfish populations may be genetically connected throughout the archipelago, localized depletion of stocks in the MHI has been apparent for the past decade (WPRFMC 2005c). Table 8 provides a breakdown of the above SPR ratios for the three Hawaii zones using aggregate CPUE. With the exception of onaga in the Hoomalu Zone, all of the NWHI SPRs are above 50 percent. In the MHI, however, the SPRs are substantially lower, with the onaga SPR at around 10 percent.

Table 8: 2003 SPRs (%) by BMUS Stock by Zone.

Zone	Ehu	Hapụupụu	Onaga	Opakapaka	Uku
MHI	26	29	9	21	26
Mau	58	61	53	57	58
Hoomalu	62	63	46	62	63

Source: 2003 Bottomfish Annual Report, WPRMC 2005c.

3.3.3.2 Overfishing Criteria

Reauthorization of the MSA included additional requirements for the quantification of fish stock status with respect to overfishing. The MSA seeks to ensure long-term fishery sustainability by halting or preventing overfishing, and by rebuilding any overfished stocks. Overfishing occurs when fishing mortality (F) is higher than the level which produces MSY, defined as the maximum long-term average yield that can be produced by a stock on a continuing basis. A stock is deemed to be overfished when stock biomass (B) has fallen to a level substantially below the biomass producing MSY. There are two indicators that managers must monitor to determine the status of a fishery: the level of F in relation to F at MSY (F_{MSY}), and the level of B in relation to B at MSY (B_{MSY}).

The National Standard Guidelines (50 CFR §600.305 et. seq.) for National Standard 1 call for the development of control rules identifying "good" versus "bad" fishing conditions in the fishery and the stock, and describing how a variable such as F will be controlled as a function of some stock size variable such as B in order to achieve good fishing conditions. Because fisheries must be managed to achieve optimum yield (OY), not MSY, the MSY control rule is useful for specifying the required "objective and measurable criteria for identifying when the fishery is overfished." The National Standard Guidelines (50 CFR 600.310) refer to these criteria as "status determination criteria" and state that they must include two limit reference points or thresholds: one for F that identifies when overfishing is occurring, and a second for B or its proxy that indicates when the stock is overfished. The status determination criterion for F is the maximum fishing mortality threshold (MFMT), and minimum stock size threshold (MSST) is the criterion for B. If fishing mortality exceeds the MFMT for a period of one year or more, overfishing is occurring. If stock biomass falls below MSST in a given year, the stock or stock complex is overfished. A Council must take remedial action in the form of a new FMP, an FMP amendment, or proposed regulations when it has been determined by the Secretary of Commerce that overfishing is occurring, a stock or stock complex is overfished, either of the two thresholds is being approached, or existing remedial action to end previously identified overfishing has not resulted in adequate progress.

The National Standard Guidelines state that the MFMT may be expressed as a single number or as a function of some measure of the stock's productive capacity, and that it "must not exceed the fishing mortality rate or level associated with the relevant MSY control rule" (50 CFR 600.310(d)(2)(i)). The Guidelines further state that "to the extent possible, the MSST should equal whichever of the following is greater: one-half the MSY stock size, or the minimum stock size at which rebuilding to the MSY level would be expected to occur within 10 years if the stock or stock complex were exploited at the maximum fishing mortality threshold" (50 CFR 600.310(d)(2)(ii)). Although not required, warning reference points (e.g., B_{FLAG}) may be specified in advance of B or F approaching or reaching their respective thresholds. When such a reference point is reached, the Council may begin preparations for action to control F.

A target control rule specifies the relationship of F to B for a harvest policy aimed at achieving a given target. OY is one such target, and National Standard 1 requires that conservation and management measures both prevent overfishing and achieve OY on a continuing basis. OY is the yield that will provide the greatest overall benefits to the nation, and is defined on the basis of

MSY, as reduced by any relevant economic, social, or ecological factor. MSY is therefore an upper limit for OY. A target control rule can be specified using reference points similar to those used in the MSY control rule, such as F_{TARGET} and B_{TARGET}. While MSST and MFMT are limits, the target reference points are guidelines for management action, not constraints. The technical guidance for National Standard 1 states that “Target reference points should not be exceeded more than 50 percent of the time, nor on average” (Restrepo et al. 1998).

A supplement to Amendment 6 of the Bottomfish FMP, approved by NMFS in 2003 (68 FR 46112; August 5, 2003), specified how the Council would comply with the new requirements of National Standard 1. Because of the paucity of data for all bottomfish species and island areas managed under the Bottomfish FMP, the Council’s control rules and overfishing thresholds are specified for multi-species complexes. Standardized values of catch per unit effort and fishing effort are used as proxies for biomass and fishing mortality, respectively. The stock status determination criteria are specified for those proxies using defaults recommended in the NMFS technical guidance for implementing National Standard 1.

The MSY control rule is specified as the MFMT. The MFMT and MSST are dependent on the natural mortality rate (M), an estimate of which is published annually in the SAFE report.

In addition to the thresholds MFMT and MSST, a warning reference point, B_{FLAG}, is also specified at a point above the MSST to provide a trigger for consideration of management action prior to B reaching the threshold.

MFMT, MSST, and B_{FLAG} are specified as follows:

MFMT: $F(B) = F_{MSY}B/cB_{MSY}$ **for** $B \le cB_{MSY}$

$F(B) = F_{MSY}$ **for** $B > cB_{MSY}$

MSST: cB_{MSY}

B_{FLAG}**:** B_{MSY}

Where $c = \max(1 - M, 0.5)$

Standardized values of fishing effort (E) and catch-per-unit-effort (CPUE) are used as proxies for F and B, respectively, so E_{MSY}, $CPUE_{MSY}$, and $CPUE_{FLAG}$ are used as proxies for F_{MSY}, B_{MSY}, and B_{FLAG}, respectively. In cases where reliable estimates of $CPUE_{MSY}$ and E_{MSY} are not available, they are estimated from catch and effort time series, standardized for all identifiable biases. In Hawaii, archipelago-wide estimates of the reference points are calculated as the weighted averages of estimates for each of the three management zones.

A secondary set of reference points is specified to evaluate stock status with respect to recruitment overfishing. A secondary “recruitment overfishing” control rule is specified to control fishing mortality with respect to that status. The rule can be applied only to those component stocks (species) for which adequate data are available. The ratio of a current spawning stock biomass proxy ($SSBP_t$) to a given reference level ($SSBP_{REF}$) is used to determine if individual stocks are experiencing recruitment overfishing. SSBP is CPUE scaled by percent mature fish in the catch. When the ratio $SSBP_t/SSBP_{REF}$, or the “SSBP ratio” (SSBPR) for any species drops below a certain limit ($SSBPR_{MIN}$), that species would be considered to be recruitment overfished and management measures would be implemented to reduce fishing mortality on that species, regardless of the effects on other species within the stock complex. The rule would apply only when the SSBPR drops below the $SSBPR_{MIN}$, but it would continue until the ratio achieves the "SSBPR recovery target" ($SSBPR_{TARGET}$), which would be set at a level no less than $SSBPR_{MIN}$. These two reference points and their associated recruitment overfishing control rule, which prescribes a target fishing mortality rate ($F_{RO\text{-}REBUILD}$) as a function of the SSBP ratio, are as specified below, with E_{MSY} again used as a proxy for F_{MSY}.

$F_{RO\text{-}REBUILD}$: F(SSBPR) = 0 for SSBPR $\leq$ 0.01

F(SSBPR) = 0.2F_{MSY} for 0.10 < SSBPR $\leq$ $SSBPR_{MIN}$
F(SSBPR) = 0.4F_{MSY} for $SSBPR_{MIN}$ < SSBPR $\leq$ $SSBPR_{TARGET}$

$SSBPR_{MIN}$: 0.02
$SSBPR_{TARGET}$: 0.30

3.3.3.3 Maximum Sustainable Yield (MSY)

Reference values for biomass and fishing mortality are needed for application of the control rules. Since estimates of biomass and fishing mortality are not available for any of the areas involved, proxies of CPUE and effort at MSY, respectively, are used to establish reference values. The current values for CPUE and E are compared to the reference values and their ratio determines the current status of the fishery relative to control rule thresholds. The best available reference value estimates are used. Refinement of reference value estimates and standardization of catch and effort data for the bottomfish fishery are ongoing activities and those applied here will change as better data become available.

For Hawaii, the time series of data allowed the application of a simple dynamic surplus production model. A three parameter model was fit to the NWHI daily CPUE and the MHI per trip CPUE time series with parameters of intrinsic rate of increase, r; Mau zone carrying capacity, k; and MHI catchability, q. NWHI zone q values used in the model were based on standardized estimates obtained from a research depletion study carried out in the CNMI. A four-step pattern of MHI q was used to simulate changes in catchability expected from changes in technology and experience of MHI fishermen. Carrying capacity values for the Hoomalu zone and MHI were based on the Mau zone k adjusted by relative length of 100-fathom contour for the zones. The reference values obtained for each zone are presented in Table 9.

Table 9: MSY and Reference Values (CPUE and Effort at MSY) by Area.

Zone	MSY	CPUE at MSY	Effort at MSY
MHI	353,435 pounds	407 lb/trip	868 trips
Mau Zone	97,904 pounds	470 lb/day	208 days
Hoomalu Zone	339,728 pounds	431 lb/day	789 days

Source: Kobayashi and Moffitt 2005.

The control rule uses the reference values to establish thresholds. The current status of the fishery is determined by the ratio of current values of CPUE and effort compared to the reference values. The MFMT is set at the effort at MSY, such that overfishing is occurring when the current effort ratio is greater than 1.0. The biomass threshold, MSST, is defined as 1.0 minus natural mortality. Natural mortality for species of the bottomfish complex is largely unknown, therefore, estimates are used. Various sources report natural mortality estimates ranging from 0.30 to 0.90. The precautionary value of 0.30 was selected for the purpose of establishing the MSST. The resulting MSST is 0.70. The current status of the stocks for the various island areas are presented in Table 10.

Table 10: Current Status of Bottomfish in Hawaii's Management Sub-areas (2003 data).

Zone	CPUE Ratio (current/MSY)	Effort Ratio (current/MSY)
Threshold	Above 0.7	Below 1.0
Hawaii, all areas combined	0.82	1.13
MHI	0.47	1.88
Mau Zone	1.01	0.96
Hoomalu Zone	1.13	0.39

Source: PIFSC 2005; Appendix 2.

In 1998, the State of Hawaii established bottomfish restricted fishing areas encompassing approximately 20 percent of the 100 fathom contour in the MHI. Commercial CPUE and effort data thus far do not reflect any benefit in terms of increased biomass or decreased fishing mortality obtained from these closures.

Under the National Standard 1 guidelines, Hawaii's archipelagic bottomfish multi-species stock complex is not overfished (the biomass standard using CPUE as a proxy). The current CPUE ratio is 0.82, above the threshold value of 0.7 established as the MSST. However, overfishing (the fishing mortality standard using fishing effort as a proxy) is occurring. The 2003 effort ratio is 1.13, above the threshold value of 1.0 established as the MFMT.

The Secretary of Commerce informed the Council on May 27, 2005, that according to MSA National Standard 1 guidelines and the associated reference points adopted by the Council, the bottomfish multi-species stock complex in the Hawaii archipelago is experiencing overfishing. On behalf of the Secretary of Commerce, the Regional Administrator for the Pacific Islands Region notified the Council of this overfishing determination on May 27, 2005 (70 FR 34452, June 14, 2005). As stated in the overfishing notification letter, "the MHI is the zone that contributes most of the problems in terms of both reduced biomass and overfishing." The overfishing notification letter further states, "[t]herefore, it is likely that reducing fishing mortality here [MHI] would be the most effective means to end overfishing in the Hawaiian Archipelago (70 FR 3442, June 14, 2005)." The Council is required to take action end the overfishing within one year following the notification (70 FR 34552, June 14, 2005).

3.4 Fisheries

The deep-slope bottomfish fishery in Hawaii concentrates on species of eteline snappers, carangids and a single species of grouper concentrated at depths of 30 to 150 fathoms (55 to 275 m). The fishery can be divided into two geographical areas (see Figure 1) the inhabited MHI with their surrounding reefs and offshore banks; and the NWHI, a chain of largely uninhabited islets, reefs and shoals extending 1,200 nautical miles across the North Pacific. In the MHI approximately 80 percent of the bottomfish habitat lies in state waters. Bottomfish fishing grounds within federal waters (3 to 200 nm offshore) around the MHI include Middle Bank, most of Penguin Bank and approximately 45 nautical miles of 100-fathom bottomfish habitat in the Maui–Lanai–Molokai complex (Figure 7).

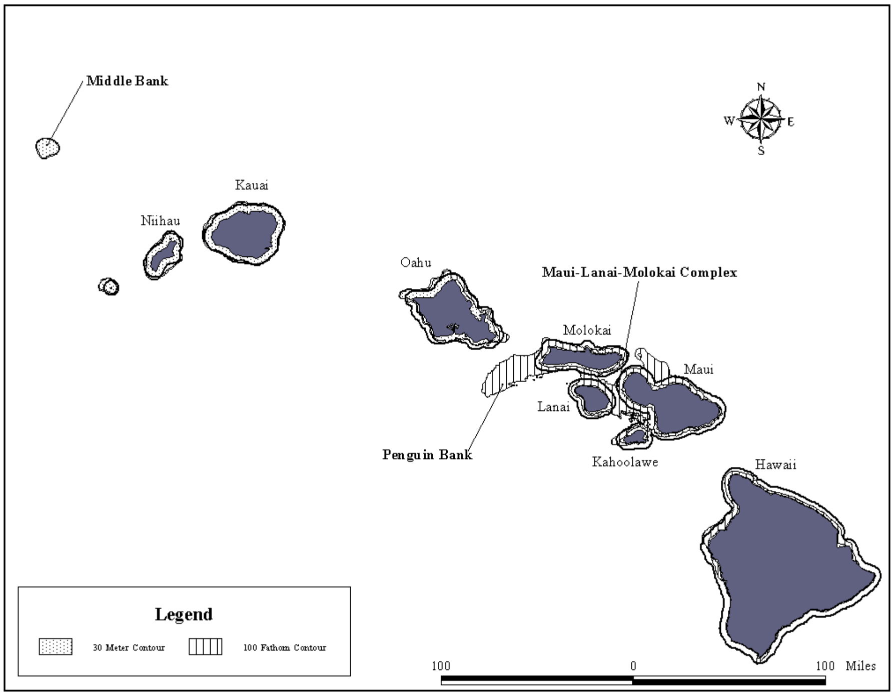


Figure 7: Bottomfish Habitat in the MHI.

Data from various surveys indicate that the importance of the MHI fishery varies significantly among fishermen of different islands. According to a 1987 survey of boat fishing club members, bottomfish represented roughly 13 percent of the catch of Hawaii fishermen, 25 percent of the catch of Oahu and Kauai fishermen, and 75 percent of the catch of Maui fishermen (Meyer Resources 1987). A survey of licensed commercial fishermen conducted about the same time indicated that the percentage of respondents who used bottomfish fishing methods was 25 percent on Hawaii, 28 percent on Kauai, 29 percent on Oahu, 33 percent on Lanai, 50 percent on Molokai and 51 percent on Maui (Harman and Katekaru 1988). Presumably, the differences among islands relate to the proximity of productive bottomfish fishing grounds.

Roughly 30 percent of the MHI commercial landings of the Deep 7 species from 1998 to 2004 are from Oahu. Maui landings from the same time period represent 36 percent, with Hawaii, Kauai and Molokai/Lanai representing 18, 10 and 5 percent, respectively (Kawamoto and Tau 2005). Specific bottomfish fishing locales favored by fishermen vary seasonally according to sea conditions and the availability and price of target species. Historically, Penguin Bank is one of the most important bottomfish fishing grounds in the MHI, as it is the most extensive shallow shelf area in the MHI and within easy reach of major population centers. Penguin Bank is particularly important for the MHI catch of uku, one of the few bottomfish species available in substantial quantities to Hawaii consumers during summer months.

3.4.1 History

Bottomfish fishing was a part of the economy and culture of the indigenous people of Hawaii long before European explorers first visited the islands. Descriptions of traditional fishing practices indicate that Native Hawaiians harvested the same deep-sea bottomfish species as the modern fishery, and used some of the same specialized gear and techniques employed today (Iversen et al. 1990). The *pọo lawạịa* (expert fishermen) within the community knew of dozens of specific *kọa* (fishing areas) where bottomfish could be caught (Kahaulelio 1902). As Beckley (1883) noted, each *kọa* could be precisely located:

> Every rocky protuberance from the bottom of the sea for miles out, in the waters surrounding the islands, was well known to the ancient fishermen, and so were the different kinds of rock fish likely to be met with on each separate rock. [They] took their bearing for the purpose of ascertaining the rock which was the habitat of the particular fish they were after, from the positions of the different mountain peaks.

European colonization of the Hawaiian Islands during the early nineteenth century and the introduction of a cash economy led to the development of a local commercial fishery. As early as 1832, fish and other commodities were sold near the waterfront in Honolulu (Reynolds 1835). Other fish markets were established on the islands of Maui and Hawaii. John Cobb (1902), who investigated Hawaii's commercial fisheries in 1900 for the U.S. Fish Commission, reported that the bottomfish̩ ulạula, uku, and ulua were three of the five fish taken commercially on all the Hawaiian Islands.

Initially, the commercial fishing industry in Hawaii was monopolized by Native Hawaiians, who supplied the local market with fish using canoes, nets, traps, spears and other traditional fishing devices (Cobb 1902; Jordan and Evermann 1902). However, the role that Native Hawaiians played in Hawaii's fishing industry gradually diminished during the latter half of the nineteenth century as successive waves of immigrants of various races and nationalities arrived in Hawaii.

Between 1872 and 1900, the non-indigenous population increased from 5,366 to 114,345 (Office of Hawaiian Affairs 1998). Kametaro Nishimura, credited by some to be the first Japanese immigrant to engage in commercial fishing in Hawaii, began his fishing career in the islands in 1885, harvesting bottomfish such as ōpakapaka, ulua, and uku (Miyaski 1973). By the turn of the century, Japanese immigrants to Hawaii dominated the bottomfish fishery using wooden-hulled "sampans" propelled by sails or oars (Cobb 1902). The sampan was brought to Hawaii by Japanese immigrants during the late nineteenth century, and over time Japanese boat builders in Hawaii adapted the original design to specific fishing conditions found in Hawaii (Goto et al. 1983). The bottomfish fishing gear and techniques employed by the Japanese immigrants were imitations of those traditionally used by Native Hawaiians, with slight modifications (Konishi 1930).

During the early years of the commercial bottomfish fishery, vessels restricted their effort to areas around the MHI. Cobb (1902) recorded that some of the best fishing grounds were off the coast of Molokai and notes that large sampans with crews of four to six men were employed in the fishery. Typically, the fleet would leave Honolulu for the fishing grounds on Monday and return on Friday or Saturday. The fishing range of the sampan fleet increased substantially after the introduction of motor powered vessels in 1905 (Carter 1962). Fishing activity was occurring around the NWHI at least as early as 1913, when one commentator stated: "Fishing for *ulua* and *kahala* is most popular, using *bonito* for bait, fishermen seek this [sic] species in a 500 mile range toward Tori-Jima [NWHI]" (Japanese Consulate 1913, as cited in Yamamoto 1970:107). Within a few years more than a dozen sampans were fishing for bottomfish around the NWHI (Anon. 1924; Konishi 1930). Fishing trips to the NWHI typically lasted 15 days or more, and the vessels carried 7 to 8 tons of ice to preserve their catch (Nakashima 1934). The number of sampans traveling to the more distant islands gradually declined because of the limited shelter the islands offered during rough weather and the difficulty of maintaining the quality of the catch during extended trips (Konishi 1930). However, during the 1930s, at least five bottomfish fishing vessels ranging in size from 65 to 70 feet continued to operate in the waters around the NWHI (Hau 1984). In addition to catching bottomfish, the sampans harvested lobster, reef fish, turtles, and other marine animals (Iversen et al. 1990).

During World War II, the bottomfish fishery in Hawaii virtually ceased operations, but recommenced shortly after the war ended (Haight et al. 1993a). The late 1940s saw as many as nine vessels fishing around the NWHI. By the mid-1950s, vessel losses and depressed fish prices resulting from large catches had reduced the number of fishery participants. During the 1960s, only one or two vessels were operating around the NWHI.

There was renewed interest in harvesting the bottomfish resources of the NWHI in the late 1970s following a collaborative study of the marine resources of the region by state and federal agencies (Haight et al. 1993a). The entry of several modern boats into the NWHI fishery and the resultant expanding supply of high-valued bottomfish such as ōpakapaka and onaga made possible the expansion of the tourism-linked restaurant market by allowing a regular and consistent supply of relatively fresh fish (Pooley 1993a). Markets for Hawaii bottomfish further expanded after wholesale seafood dealers began sending fish to the U.S. mainland. By 1987, 28 vessels were active in the NWHI bottomfish fishery, although only 12 were fishing for bottomfish full time. Some of the non–full-time vessels also engaged in the pelagic or lobster fisheries (Iversen et al. 1990). In 1989, the Council developed regulations that divided the fishing grounds of the NWHI bottomfish fishery into the Hoomalu Zone and Mau Zone. Limited access programs were established for the Hoomalu Zone and Mau Zone in 1988 and 1999, respectively, to avoid economic overfishing (Pooley 1993b; WPRFMC 1998b).

The 1970s also saw major changes in the composition and operations of the bottomfish fishery around the main Hawaiian Islands. The fishery changed from one dominated, in terms of catch and effort, by a relatively small number of full-time professional fishermen to one dominated by hundreds of part-time commercial and recreational fishermen. This change was the result of a number of factors. The popularity of offshore fishing increased in Hawaii with the increase in the availability of both locally built and imported small fiberglass boats. In addition, the rise in fuel prices during the 1970s made fishing for bottomfish particularly attractive to fishermen as it consumed less fuel than trolling and generated higher-value fish catches to offset fuel costs. Finally, as navigation systems, bottom-sounders and hydraulic or electric powered reels became more affordable, the skill level and experience necessary to fish bottomfish successfully was reduced and the labor associated with hauling up the long lines was considerably lightened.

During the early 1980s, with the development of a much larger market for bottomfish, bottomfish fishermen fishing around the main Hawaiian Islands were able to obtain premium prices for their catches, and thus were motivated to increase their landings (Pooley 1993a). However, the number of vessels participating in the MHI fishery declined after reaching a peak of 583 in 1985. The decrease in fishing effort suggests that some bottomfish fishermen perceived a growing shortage of bottomfish in the MHI fishery and switched to other fisheries, particularly targeting pelagics. Currently, most fishermen landing bottomfish commercially switch between fisheries targeting seasonal abundance and market prices. Very few fishermen target bottomfish exclusively year round

In 1998, concerns generated from PIFSC and the Council's Bottomfish Plan Team about low SPR values in the MHI led the State of Hawaii to close certain areas around the MHI to bottomfish fishing, including areas of Penguin Bank within the EEZ.[9] In addition, new state rules established a recreational bag limit of five onaga or ehu, or a mix of both, per person per day. This bottomfish management regime requires any person who may fish for bottomfish (any of the seven species) to register their vessel with the HDAR and display the letters "BF" on their boat. This rule applies to all vessels used for targeting bottomfish fishing, whether the owner is a recreational/subsistence fisherman or a commercial fisherman. Of the 3,600 vessels registered with the HDAR as of August 2005, about 40 percent declared themselves recreational fishermen (HDAR Bottomfish Survey 2005). It is unknown how many of these vessels, registered as recreational, have fished for bottomfish since 1998.

Hawaii's sport fishing charter boat fleet began to develop during the early 1950s as Hawaii became an increasingly popular tourist destination (Markrich 1994). What started as a few

[9] The State of Hawaii claims the authority to manage and control the marine, seabed, and other resources within "archipelagic waters." These archipelagic waters encompass a number of bottomfish fishing grounds, such as parts of Penguin Bank, that lie inside the EEZ. An October 24, 1997, memorandum from NOAA/General Counsel Southwest Region to the Council Chairman declared that, despite any contentions by the State of Hawaii to the contrary, for purposes of federal fishery management, state waters do not extend beyond 3 miles from the coast.

charter boats operating out of harbors such as Kewalo Basin and Kona has evolved into a highly competitive industry involving nearly 200 vessels statewide (Hamilton 1998; Walker 1996). The charter boat fleet mainly targets pelagic game fish such as billfish and tuna. However, a few charter boats take bottomfish fishing trips if patrons are interested (Hamilton 1998). Most of the charter boats engaged in bottomfish fishing are based on the islands of Maui and Kauai.

3.4.2 Fishing Gear and Methods

The basic design of the handline gear used in Hawaii's bottomfish fisheries has remained essentially unchanged from gear used by early Native Hawaiians (Haight et al. 1993a). The gear consists of a main line with a 2 to 4 kilograms weight attached to the terminus. Several 40 to 60 centimeters sidelines with circle hooks are attached above the weight at 0.5 to 1.0 meters intervals. A chum bag containing chopped fish or squid may be suspended above the highest of these hooks. The gear is pulled after several fish are hooked.

Circle hooks used in the bottomfish fishery are flat by design. "Kirbed" hooks (bent or offset to the side) are also available but are not generally used. The flat circle hooks are designed to be self-setting and work well for fish that engulf the bait and move off with it in their mouth. As a fish moves off with the baited hook, the line will trail out of the corner of the fish's mouth. The hook will be drawn into the corner of the mouth where the motion of the fish in relation to the pull of the line will rotate the hook through the corner of the jaw. Circle hooks, unlike J type hooks, are generally not effective for fish that pick at the bait or mouth the bait and spit it out (K. Kawamoto, PIFSC, personal communication).

Fishermen use the circle hook for its self-setting ability and for its curved design with its long inward pointing hook point that makes it difficult for the fish to rid itself of the hook once it is embedded. The circle hook shank is typically thicker and round in cross section (unlike the thinner straight J type hooks), which tends to minimize ripping or wearing a hole in the fish's jaw. An additional characteristic of the circle hook design that appeals to fishermen is that it's less prone to snagging on rocky or hard substrate bottoms and very difficult to snag flat or smooth surfaces. This characteristic minimizes the loss of gear (K. Kawamoto, PIFSC, personal communication).

All bottomfish fishermen in Hawaii target the same assemblage of bottomfish species. The ability to target particular species varies widely depending on the skill of each captain. Electronic navigation and fish-finding equipment greatly aid fishermen in returning to a particular fishing spot and catching desired species with little incidental catch (Haight et al. 1993a). According to Hau (1984), ʻōpakapaka is one of the primary target species due to the relatively high price it commands as a result of its constant demand at the fish auction. Hāpuʻupuʻu and white ulua are sought because of their sturdiness and ability to retain good flesh quality. In addition, white ulua can be caught in rough sea conditions when other species are difficult to capture. Because of potential ciguatera toxicity, however, ulua are not usually targeted. Kāhala are one of the least valuable bottomfish because large specimens have a reputation for carrying the ciguatera toxin, and because of high densities of parasites in the flesh.

As detailed in Section 3.3.1.1, commercially important deepwater bottomfish inhabit the deep slopes of island coasts and banks at depths of 100 to 400 meters. The distribution of adult bottomfish is highly correlated with suitable physical habitat. In addition to depth, both the quantity and quality of habitat are important and generally include locations of high-relief areas with water movement. Fishermen target specific areas by drifting or anchoring their vessels taking into consideration ocean currents (both surface and at depth), wind speed and direction and sea conditions. These environmental constraints limit the time during which bottomfish fishing can be conducted.

3.4.3 Existing Regulatory Regimes

3.4.3.1 Federal Management Regime

3.4.3.1.1 Overview of the Fishery Management Plan (FMP) and Amendments

The Fishery Management Plan for Bottomfish and Seamount Groundfish of the Western Pacific Region (Bottomfish FMP) was implemented in 1986. It prohibits certain destructive fishing techniques, including explosives, poisons, trawl nets and bottom-set gillnets; establishes a moratorium on the commercial harvest of seamount groundfish stocks at the Hancock Seamounts; and implements a permit system for fishing for bottomfish in the EEZ around the NWHI. (The moratorium on the commercial harvest of seamount groundfish stocks at the Hancock Seamounts, the only exploitable seamount habitat in the management area, remains in effect. At its 123rd meeting (June 21–24, 2004), the Council approved an extension of the moratorium until August 31, 2010 (69 FR 51400). Consequently, there is no seamount groundfish fishery in the region. The plan also establishes a management framework that includes adjustments such as catch limits, size limits, area or seasonal closures, fishing effort limitation, fishing gear restrictions, access limitation, permit and/or catch reporting requirements and a rules-related notice system.

The Bottomfish FMP has been amended seven times since 1986. Implemented in 1987, Amendment 1 includes the establishment of potential limited access systems for bottomfish fisheries in the EEZ surrounding American Samoa and Guam within the framework measures of the Bottomfish FMP. Amendment 2 (1988) divides the EEZ around the NWHI into two zones: the Hoomalu Zone to the northwest and the Mau Zone to the southeast. The amendment also establishes a limited access system for the Hoomalu Zone. Amendment 3 (1991), which has been supplanted by Amendment 6, defines recruitment overfishing as a condition in which the ratio of the spawning stock biomass per recruit at the current level of fishing to the spawning stock biomass per recruit that would occur in the absence of fishing is equal to or less than 20 percent. Amendment 3 also delineates the process by which overfishing is monitored and evaluated. Amendment 4 (1990) requires vessel owners or operators to notify NMFS at least 72 hours before leaving port if they intend to fish in a 50 nautical miles "protected species study zone" around the NWHI. This notification allows federal observers to be placed on board bottomfish vessels to record interactions with protected species if this action is deemed necessary. Amendment 5 (1999) establishes a limited access system for the Mau Zone and a framework for a Community Development Program. Amendment 6 (1999) identifies and describes essential fish habitat for managed species of bottomfish, discusses measures to minimize bycatch and bycatch mortality in the bottomfish fishery, provides criteria for identifying when overfishing has occurred in the fishery and describes fishing communities in the region. Amendment 6 initially was only partially approved, with the provisions for bycatch, overfishing and fishing communities in Hawaii disapproved. The disapproved provisions were rewritten and the revised provisions have been implemented. Amendment 7 (2003) brings the Bottomfish FMP into conformity with the Coral Reef Ecosystem (CRE) FMP by prohibiting fishing for BMUS in the CRE FMP's no-take areas, and amending the BMUS list to exclude species now managed under the CRE FMP.

4.3.1.2 Fisheries Management Plan (FMP) Regulations

For the complete list of federal regulations for Western Pacific Region fisheries, see 50 CFR Part 660. The following can be found at 50 CFR § 660.61.

Gear Restrictions

(1) Fishing for bottomfish and seamount groundfish with bottom trawls and bottom-set gillnets is prohibited.
(2) Possession of a bottom trawl and bottom-set gillnet by any vessel having a Hoomalu Zone permit or Mau Zone permit or otherwise established to be fishing for bottomfish or seamount groundfish in the management sub-areas is prohibited.
(3) The possession or use of any poisons, explosives, or intoxicating substances for the purpose of harvesting bottomfish and seamount groundfish is prohibited.

Permits

(1) The owner of any vessel used to fish for BMUS in the NWHI sub-area must have a permit and the permit must be registered for use with the vessel. A single vessel cannot be registered for use with a Hoomalu Zone permit and a Mau Zone permit at the same time.
(2) Hoomalu Zone limited access permit:

(i) A Hoomalu Zone permit may not be sold or otherwise transferred to a new owner. A Hoomalu Zone permit or permits may be held by a partnership or corporation. If 50 percent or more of the ownership of the vessel passes to persons other than those listed in the original application, the permit will lapse and must be surrendered to the NMFS Regional Administrator.

(ii) Upon application by the owner of a permitted vessel, the NMFS Regional Administrator will transfer that owner's permit to a replacement vessel owned by that owner, provided that the replacement vessel does not exceed 60 feet (18.3 m) in length. The replacement vessel must be put into service no later than 12 months after the owner applies for the transfer, or the transfer shall be void. An owner of a permitted vessel may apply to the Regional Administrator for transfer of that owner's permit to a replacement vessel greater than 60 feet (18.3 meters) in length. The Regional Administrator may transfer the permit upon determining, after consultation with the Council and considering the objectives of the limited access program, that the replacement vessel has catching power that is comparable to the rest of the vessels holding permits for the fishery, or has catching power that does not exceed that of the original vessel, and that the transfer is not inconsistent with the objectives of the program. The Regional Administrator shall consider vessel length, range, hold capacity, gear limitations, and other appropriate factors in making determinations of catching power equivalency and comparability of the catching power of vessels in the fishery.

(iii) Hoomalu Zone limited access permit renewal: A qualifying landing for Hoomalu Zone permit renewal is a landing of at least 2,500 pounds (1,134 kg) of BMUS from the Hoomalu Zone or a landing of at least 2,500 pounds (1,134 kg) of fish from the Hoomalu Zone, of which at least 50 percent by weight was BMUS. A permit is eligible for renewal for the next calendar year if the vessel covered by the permit made three or more qualifying landings during the current calendar year.

(iv) The NMFS Regional Administrator may issue new Hoomalu Zone limited access permits if the Regional Administrator determines, in consultation with the Council that bottomfish stocks in the Hoomalu Zone are able to support additional fishing effort. When the Regional Administrator has determined that new permits may be issued, they shall be issued to applicants based upon eligibility, determined as follows:

(a) Point system:

Two points will be assigned for each year in which the applicant was owner or captain of a vessel that made three or more of any of the following types of landings in the NWHI: Any amount of BMUS, regardless of weight, if made on or before August 7, 1985; at least 2,500 pounds (1,134 kg) of BMUS, if made after August 7, 1985; or at least 2,500 pounds (1,134 kg) of any fish lawfully harvested from the NWHI, of which at least 50 percent by weight was bottomfish, if made after August 7, 1985. One point will be assigned for each year in which the applicant was owner or captain of a vessel that landed at least 6,000 pounds (2,722 kg) of bottomfish from the MHI. For any 1 year, points will be assigned for landings in the NWHI sub-area or MHI sub-area, but not in both sub-areas. New permits shall be awarded to applicants in descending order, starting with the applicant with the largest number of points. If two or more persons have an equal number of points, and there are insufficient new permits for all such applicants, the new permits shall be awarded by the Regional Administrator through a lottery.

(b) Before the NMFS Regional Administrator issues a Hoomalu Zone permit to fish for bottomfish, the primary operator and relief operator named on the application form must have completed a protected species workshop conducted by NMFS.

(c) An applicant must own at least a 25 percent share in the vessel that the permit would cover, and only one permit will be assigned to any vessel.

(3) Mau Zone limited access permit:

(i) Eligibility for new Mau Zone limited access permits:

(a) The NMFS Pacific Islands Regional Office (PIRO) will issue an initial Mau Zone permit to a vessel owner who qualifies for at least 3.0 points under the following point system: An owner who held a Mau Zone permit on or before December 17, 1991, and whose permitted vessel made at least one qualifying landing of BMUS on or before December 17, 1991, shall be assigned 1.5 points; an owner whose permitted vessel made at least one qualifying landing of BMUS during 1991 shall be assigned 0.5 point; an owner whose permitted vessel made at least one qualifying landing of BMUS during 1992 shall be assigned 1.0 point; an owner whose permitted vessel made at least one qualifying landing of BMUS during 1993 shall be assigned 1.5 points; an owner whose permitted vessel made at least one qualifying landing of BMUS during 1994 shall be assigned 2.0 points; an owner whose permitted vessel made at least one qualifying landing of BMUS during 1995 shall be assigned 2.5 points; and an owner whose permitted vessel made at least one qualifying landing of BMUS during 1996 shall be assigned 3.0 points. A “qualifying landing” means any amount of BMUS lawfully harvested from the Mau

Zone and offloaded for sale. No points shall be assigned to an owner for any qualifying landings reported to the State of Hawaii more than 1 year after the landing.

(b) More than one Mau Zone permit may be issued to an owner of two or more vessels provided each of the owner's vessels for which a permit will be registered for use has made the required qualifying landings for the owner to be assigned at least 3.0 eligibility points.

(c) A Mau Zone permit holder who does not own a vessel at the time initial permits are issued must register the permit for use with a vessel owned by the permit holder within 12 months from the date the permit was issued. In the interim, the permit holder may register the permit for use with a leased or chartered vessel. If within 12 months of initial permit issuance, the permit holder fails to apply to the NMFS PIRO to register the permit for use with a vessel owned by the permit holder, then the permit expires.

(d) Before the NMFS PIRO issues a Mau Zone permit to fish for bottomfish, the primary operator and relief operator named on the application form must have completed a protected species workshop conducted by NMFS.

(e) A Mau Zone permit may be held by an individual, partnership, or corporation. No more than 49 percent of the underlying ownership interest in a Mau Zone permit may be sold, leased, chartered, or otherwise transferred to another person or entity. If more than 49 percent of the underlying ownership of the permit passes to persons or entities other than those listed in the original permit application supplemental information sheet, then the permit expires and must be surrendered to the NMFS PIRO. A Mau Zone permit holder may apply to the NMFS PIRO to register the permit for use with another vessel if that vessel is owned by the permit holder and is no longer than 60 feet (18.3 m). If a Mau Zone permit holder sells the vessel, for which the permit is registered for use, the permit holder must within 12 months of the date of sale apply to the NMFS PIRO to register the permit for use with a vessel owned by the permit holder. If the permit holder has not applied to register a replacement vessel within 12 months, then the permit expires. If a permitted vessel owned by the permit holder is sold or becomes not seaworthy, the Mau Zone permit with which the vessel was registered may be registered for use with a leased or chartered vessel for a period not to exceed 12 months from the date of registration of the leased or chartered vessel. If by the end of that 12-month period the permit holder fails to apply to the NMFS PIRO to register the permit for use with a vessel owned by the permit holder, then the permit expires.

(ii) A Mau Zone permit will be eligible for renewal if the vessel for which the permit is registered for use made at least five separate fishing trips with landings of at least 500 pounds (227 kg) of BMUS per trip during the calendar year. Only one landing of BMUS per fishing trip to the Mau Zone will be counted toward the landing requirement. If the vessel for which the permit is registered for use fails to meet the landing requirement, the owner may apply to the NMFS Regional Administrator for a waiver of the landing requirement. Grounds for a waiver are limited to captain incapacitation, vessel breakdowns, and the loss of the vessel at sea if the event prevented the vessel from meeting the landing requirement. Lack of profitability is not sufficient for waiver of the landing requirement.

Prohibitions

It is unlawful for any person to do any of the following:
(1) Fish for bottomfish or seamount groundfish using prohibited gear.

(2) Fish for, or retain on board a vessel BMUS in the Hoomalu Zone or Mau Zone without the appropriate permit registered for use with that vessel.
(3) Serve as primary operator or relief operator on a vessel with a Mau Zone or Hoomalu Zone permit without completing a protected species workshop conducted by NMFS.
(4) Fail to notify the USCG at least 24 hours prior to making any landing of bottomfish taken in the Hoomalu Zone.
(5) Fish within any protected species study zone in the NWHI without notifying the NMFS PIRO of the intent to fish in these zones. Protected species study zones means the waters within 50 nautical miles around the following islands of the NWHI and as measured from the following coordinates: Nihoa Island 23°05' N latitude, 161°55' W longitude; Necker Island 23°35' N latitude, 164°40' W longitude; French Frigate Shoals 23°45' N latitude, 166°15' W longitude; Gardner Pinnacles 25°00' N latitude, 168°00' W longitude; Maro Reef 25°25' N latitude, 170°35' W longitude; Laysan Island 25°45' N latitude, 171°45' W longitude; Lisianski Island 26°00' N latitude, 173°55' W longitude; Pearl and Hermes Reef 27°50' N latitude, 175°50' W longitude; Midway Island 28°14' N latitude, 177°22' W longitude; and Kure Island 28°25' N latitude, 178°20' W longitude.

Notification

(1) The owner or operator of a fishing vessel must inform the NMFS PIRO at least 72 hours (not including weekends and holidays) before leaving port of his or her intent to fish within the protected species study zones. The notice must include the name of the vessel, name of the operator, intended departure and return dates, and a telephone number at which the owner or operator may be contacted during the business day (8 a.m. to 5 p.m.) to indicate whether an observer will be required on the subject fishing trip.
(2) The operator of a fishing vessel that has taken bottomfish in the Hoomalu Zone must contact the USCG, by radio or otherwise, at the 14th District, Honolulu, HI; Pacific Area, San Francisco, CA; or 17th District, Juneau, AK, at least 24 hours before landing, and report the port and the approximate date and time at which the bottomfish will be landed.

At-Sea Observer Coverage

All fishing vessels must carry an observer when directed to do so by the NMFS Regional Administrator.

Reporting and Recordkeeping

Any person who is required to do so by applicable state law or regulation must make and/or file all reports of MUS landings containing all data and in the exact manner required by applicable state law or regulation.

3.4.3.1.3 Observer Program

During the period 1990–1993, observers were placed on NWHI bottomfish vessels to monitor protected species interactions, particularly interactions with the Hawaiian monk seal. More recently, the Hawaii-based NWHI bottomfish fishery has been monitored under a mandatory observer program since October 2003. Beginning then, PIRO personnel have conducted daily shore-side dock rounds in Honolulu to determine which fishing vessels are in port. The information is used to generate an estimate of fishing effort on a real-time basis by assuming that a vessel is fishing when it is absent from the harbor. From the fourth quarter of 2003 through the second quarter of 2005, observer coverage in the bottomfish fleet has averaged 21.4 percent, and there have been no interactions with protected species and bottomfish vessels.

3.4.3.1.4 Data Collection

The NMFS Pacific Islands Fishery Science Center (PIFSC) manages the Western Pacific Fisheries Information Network (WPacFIN), a partnership with the state and territorial governments in the region for collecting, processing, analyzing, sharing, and managing fisheries data. Through the cooperative efforts of the member agencies, WPacFIN provides fisheries data and information to NMFS, the Fishery Council, and its various committees and advisory bodies to develop, implement, evaluate, and amend FMPs for the region. WPacFIN staff assists island agencies (including HDAR) in designing and implementing appropriate local fisheries data collecting, monitoring, analyzing and reporting programs, complete with associated microcomputer-based data processing systems. Staff members also help promote data standards to facilitate information analyses and reports.

In regards to bottomfish fishery-dependent data collection, the HDAR has played a central role both within the MHI as well as the NWHI. Any fisherman who sells fish in Hawaii is required to have a Commercial Marine License (CML). These licenses may be “reporting” or “non-reporting.” A non-reporting license holder is typically a crewman on a vessel for which the captain does all the reporting. Reporting fishermen must submit Monthly Fishing Reports to HDAR by the tenth of the following month.

For commercial fishermen with limited-entry federal NWHI bottomfish fishing permits, a NWHI Bottomfish Trip Daily Log is required for every day fished. These forms are due to HDAR by the tenth of the month after the end of the trip. These fishermen must also complete a NWHI Bottomfish Trip Sales Report for each fishing trip, but are not required to submit the Monthly Fishing Report.

There are no mandatory reporting or permit programs for recreational fisheries in the State of Hawaii. Recreational fisheries do constitute significant harvests of fisheries resources in the state, and the lack of quality data in relation recreation fishing patterns and harvests does hamper fishery management decisions. The Hawaii Marine Recreational Fishing Survey (HMRFS) collects voluntary recreational fishing information on several fisheries in the state (e.g. shoreline pole and line); however, the HMRFS has not been effective in capturing quality data from the Hawaii recreational bottomfish fishery. In terms of landings, the recreational bottomfish fishery (those without ever having a CML and those with expired CMLs) is believed harvest at least 25 percent to 70 percent of the total bottomfish catch (HDAR Bottomfish Fishery Survey 2005).

3.4.3.1.5 Federal Enforcement

Enforcement of federal fishery regulations around Hawaii is shared by the U.S. Coast Guard and NOAA's Office of Law Enforcement. The USCG's Fourteenth District is located in Hawaii, and two high-endurance cutters are home-ported in Honolulu. These cutters perform a variety of functions, including fishery regulations enforcement, throughout the Pacific Ocean. The District's air wing is based on Oahu and consists of three C-130 aircraft and three HH-65 helicopters that are used primarily for search and rescue. The C-130s also make law enforcement flights throughout the district's area of responsibility.

The NOAA Office of Law Enforcement, Honolulu Field Office is responsible for enforcing federal laws and regulations pertaining to federally regulated fisheries and federally protected living marine resources. Four special agents, one fishery patrol officer, and three support employees routinely respond to alleged violations throughout the Hawaiian Islands and the Western Pacific Ocean. Enforcement is accomplished in cooperation with the USCG and the State of Hawaii.

3.4.3.2 State of Hawaii Management Regime

The state bottomfish fishery is managed by the Hawaii Department of Land and Natural Resources, Division of Aquatic Resources. In response to very low and decreasing SPR values for onaga and ehu in the MHI, HDAR developed and implemented new regulations for bottomfish fishing in state waters (Hawaii Administrative Rules [HAR] 13-94; effective June 1, 1998). This rule established regulations for the deep-sea bottomfish fishery managed by the state and includes gear restrictions, noncommercial bag limits, 19 areas closed to bottomfish fishing (BFRAs), requirements for registration and identification of bottomfish fishing vessels, and a control date for possible future implementation of a limited access management regime. HDAR e is currently proposing new BRFAs throughout the state (see Section 2.2.2).

3.4.3.2.1 State Regulations

State of Hawaii regulations require any person who takes marine life for commercial purposes, whether within or outside of the state, to first obtain a commercial marine license from the HDAR.

HAR 13-94, Bottomfish Management, defines "bottomfish" as seven deep-water species, including onaga, ehu, kalekale, ōpakapaka, gindai, hapụupụu, and lehi. Use or possession of nets, traps, trawls or bottomfish longlines in bottomfish fishing is prohibited. Non-commercial fishermen are limited to a maximum of five onaga or ehu, or a mix of both, per person. The rule also established 19 areas around the MHI closed to bottomfish fishing. Bottomfish fishing vessels must be registered with the state and identified with the letters "BF" and appropriate registration numbers (Department of Boating and Ocean Recreation vessel registration, federal fishery permit numbers or USCG vessel documentation number) on the vessel. A control date of June 1, 1998 was also established to potentially qualify applicants for a future limited entry program for commercial bottomfish fishing.

HAR 13-95, Rules Regulating the Taking and Selling of Certain Marine Resources, establishes a minimum size of one pound for the sale of ōpakapaka, onaga, and uku.

In September of 2005, Governor Linda Lingle, signed HAR 13 60.5, NWHI Marine Refuge, that put all State waters from Nihoa to Kure Atoll into a no extraction marine refuge. All commercial and recreational fishing is now prohibited in these waters.

3.4.3.2.2 State Data Collection

The State of Hawaii provides fishermen with a Commercial Fisheries Statistical Charts, a grid to facilitate reporting of catch by area. The inshore reporting grid areas are irregular shapes, and do not mirror known fishing grounds or habitat, and are not aligned with known management areas. The seaward boundaries of the inner grid areas generally lie two miles from shore. However, the grid has not been geo-referenced (Walter Ikehara, NMFS, formerly of HDAR, personal communication). The offshore grids are aligned by latitude and longitude on a Mercator Projection, giving standard 20 minute square grid areas. Any fisherman who sells fish in Hawaii is required to have a Commercial Marine License (CML). These licenses may be “reporting” or “non-reporting.” A non-reporting license holder is typically a crewman on a vessel for which the captain does all the reporting. Reporting fishermen must submit Monthly Fishing Reports to HDAR by the tenth of the following month. Starting March 1, 2006, HDAR begun a policy where fishermen wanting to renew their annual CML have to submit all of their missing reports or HDAR will not issue the fishermen a CML. The reason for this policy is to facilitate more complete and timely reporting (R. Kokubun, HDAR, personal communication).

The shortcomings associated with reporting bottomfish based on the Commercial Fisheries Statistical grids are particularly problematic when Penguin Bank is considered. Penguin Bank (grid 331) (Figure 8) is almost entirely in federal waters and is a highly popular bottomfish fishing area. The edge of the reporting grid parallels the bank slope which is recognized as prime bottomfish habitat. Adjacent grids, such grid 429, include the bottomfish habitat on the east coast of Oahu. Fish reported in grid 429 could have come from Makapuu Point off of east Oahu or from the western edge of Penguin Bank. However, when meeting with active bottomfish fishermen who frequent Penguin Bank, they indicate that all catches taken in the Penguin Bank area are reported as coming from 331. Another problem associated with reporting grid 331 is that it does not allow for finer evaluation of fish caught from different locations on the Bank. Without good spatial data it is difficult to predict the immediate consequences of the action, and to monitor subsequent changes when the action is taken.

The problems with the existing reporting grids are clear, however HDAR has been hesitant to revise the grid system because of concerns with an inability to compare historical to new catch area information. However, the importance of improving the reporting grid to facilitate monitoring and assessments is recognized by HDAR, and options for improving the grid are under consideration.

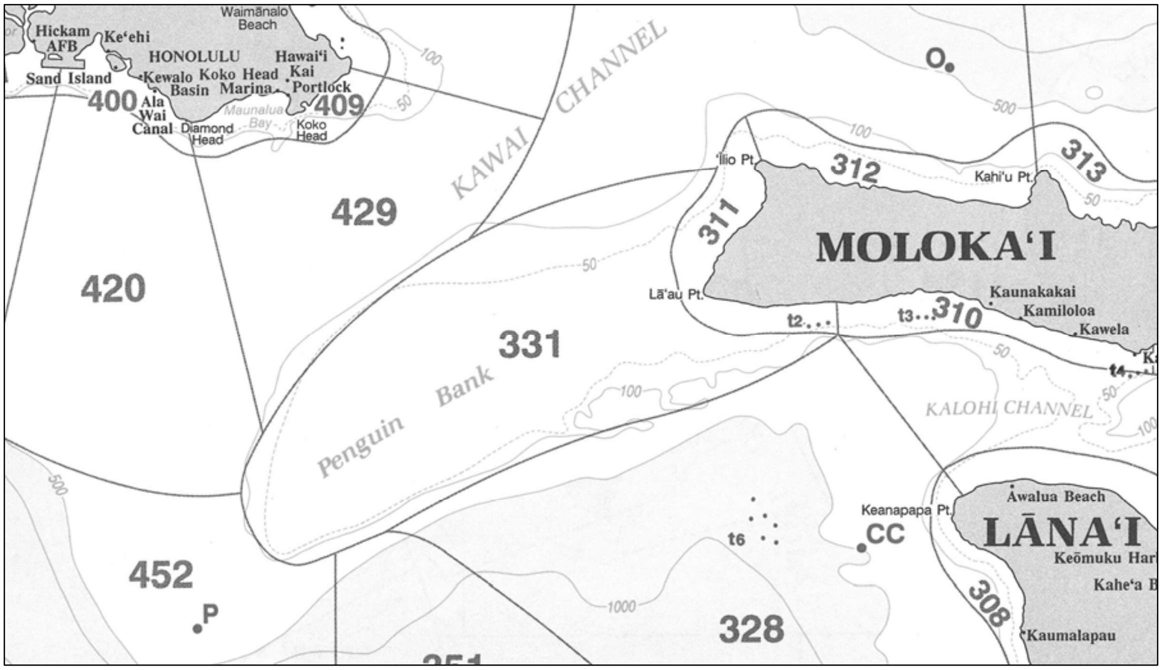


Figure 8: State of Hawaii CML Statistical Grids around Penguin Bank.

3.4.3.2.3 State Enforcement

The Board of Land and Natural Resources (BLNR), which oversees the operations of the DLNR, has police powers, and appoints and commissions enforcement officers within the Division of Conservation and Resources Enforcement. Enforcement Officers (DOCARE) enforce statutes and regulations of the state in all state lands including public lands, state parks, forest reserves, forests, aquatic life and wildlife areas, Kahoolawe Island Reserve, and any other lands and waters within the state. Violations can be dealt with through the state criminal court system, administratively, or through the BLNR. There are approximately 130 DOCARE officers in the state, and as state above, their area of responsibility is wide ranging and includes both terrestrial and marine areas. DOCARE possesses several small vessels (approximately 25 ft) and two larger vessels (approximately 35 ft).

Given the apparent lack of adequate funding to DOCARE over the past many years, DOCARE has not had the ability to properly enforce the state's existing BRFAs (G. Moniz, DOCARE, personal communication). A consistent comment heard in the public scoping meetings related to this DSEIS is that there was never any enforcement of the BRFAs, nor enforcement of the recreational bottomfish bag limit. DOCARE states that in the eight years of the state's BRFAs, they have only received two complaints about fishermen illegally fishing within a BRFA (G. Moniz, DOCARE, personal communication).

3.4.4 Commercial Fisheries

3.4.4.1 Participation and Effort

In the small boat fishery around the MHI the distinction between “recreational” and “commercial” fishermen is extremely tenuous (Pooley 1993a). A statewide survey of small boat fishermen conducted during 1995 to 1996 indicated that of the 42 fishermen interviewed who predominately use bottomfish fishing gear, 80 percent sold a portion of their catch (WPRFMC 1996). However, most of those selling fish are just trying to cover fishing trip expenses and do not expect a profit from their operation.

The individuals participating in the MHI fishery who make trips longer than 24 hours are mostly full-time commercial fishermen. They typically operate larger boats than the part-time commercial/recreational fishermen and are able to fish during rough weather and venture further from port to fish less-exploited areas off Kauai, Niihau, and east Maui that are less accessible to the small boat fishermen.

The majority of participants in the MHI fishery shift from species group to species group and from the bottomfish fishery to other fisheries, primarily the pelagic fishery, in response to seasonal fish abundance or fluctuations in price. Except for those individuals who fish commercially on a full-time basis, most fishermen usually fish for bottomfish no more than 60 days a year (WPRFMC 1996). Based on 2005 survey conducted by HDAR, Saturday is the most common day of the week to go bottomfish fishing in the MHI. Seasonal price variability causes part-time commercial fishermen to concentrate their bottomfish fishing effort during December, when they can take advantage of the year-end holiday demand for red snappers. Pelagic species are often an important secondary target during bottomfish fishing trips regardless of the season.

The number of fishermen engaged in bottomfish fishing in the MHI increased dramatically in the 1970s and 1980s, but then declined in the early 1990s, rebounded somewhat in the late 1990s, but in 2002 reached its lowest level since 1977 (Table 11; Figure 9). The decline in vessels and fishing effort may be due to the long-term decrease in catch rates in the bottomfish fishery and a shift of fishing effort towards tuna and other pelagic species.

Table 11: Number of Commercial Vessels in the MHI Bottomfish Fishery, 1948–2002.

Year	No. Vessels	Year	No, Vessels	Year	No. Vessels
1948	207	1968	116	1988	572
1949	196	1969	130	1989	537
1950	164	1970	219	1990	501
1951	126	1971	198	1991	469
1952	110	1972	185	1992	407
1953	106	1973	238	1993	403
1954	103	1974	241	1994	423
1955	108	1975	295	1995	400
1956	106	1976	306	1996	487
1957	102	1977	377	1997	502
1958	96	1978	414	1998	498
1959	76	1979	423	1999	483
1960	69	1980	461	2000	495
1961	65	1981	430	2001	404
1962	98	1982	526	2002	386
1963	110	1983	541	*2003**	325
1964	87	1984	558	*M*	465
1965	85	1985	583	*SD*	66
1966	97	1986	538		
1967	99	1987	535		

* 2003 Data Incomplete.
Source: WPRFMC 2005c..

In contrast to the MHI fishery, bottomfish fishing in the NWHI is conducted solely by part-time and full-time commercial fishermen. The vessels venturing into the NWHI tend to be larger than those fishing around the MHI, as the distance to fishing grounds is greater (Haight et al. 1993a).

The medium-sized powered vessels are 42 to 49 feet long. Because their smaller size limits fishing range and hold capacity, they usually operate in the lower (southeastern) end of the

NWHI (Mau Zone) or in the MHI. The larger powered vessels are 47 to 64 feet long. With an average fuel capacity of 1,500 gallons, the vessels have a maximum range (round trip) of 1,800 miles. The average maximum hold capacity is 4,000 pounds.

Many of the boats that fish in the Mau Zone switch to different fisheries and move to other fishing grounds during the year. The majority of vessels fish in the Mau Zone during a season that generally extends from November to April.

A 1993 survey of participants in the NWHI fishery found that vessels fishing in the Mau Zone made an average of 12.7 trips to the area to target bottomfish and 3.4 trips to target pelagic fish or a mixture of pelagic species and bottomfish (Hamilton 1994).

Because the NWHI bottomfish fishing grounds were divided into the Mau Zone and Hoomalu Zone in 1988, the Mau Zone has generally seen a greater share of the fishing effort as access to the Hoomalu Zone was restricted under a limited access program (WPRFMC 1999). Only five vessels harvested bottomfish in the Mau Zone in 1989, but during the 1990s an average of ten vessels fished in the area (Table 12). The amount of effort (fishing days) expended in the Mau Zone has fluctuated along with the number of active vessels. Mau Zone activity levels peaked in 1994 with a total of 594 fishing days as a result of a combination of relatively large fleet size and intensive activity by each vessel.

Table 12: Number of Vessels in the NWHI Bottomfish Fishery, 1984–2003.

Year	**Mau**	**Hoomalu**	**Total[2]**	**Year**	**Mau**	**Hoomalu**	**Total[2]**
1984	NA	NA	19	1995[1]	10	5	15
1985	NA	NA	23	1996[3]	13	3	16
1986	NA	NA	24	1997[3]	9	6	15
1987	NA	NA	28	1998[2]	7	7	13
1988	4	12	13	1999[3]	7	6	13
1989	5	5	10	2000[3]	6	5	11
1990	14	5	16	2001[3]	6	5	11
1991[1]	14	4	17	2002[3]	5	4	9
1992[1]	8	5	13	2003[3]	5	4	9
1993[1]	8	4	12	*M*	8.31	5.25	13.06
1994[1]	12	5	16	*SD*	3.36	1.98	2.59

Note. [1]Based on NMFS and HDAR data. [2] Total may not match sum of areas due to vessel participation in both areas. [3]Based on HDAR data. Source: WPRFMC 2005c, 2003 Bottomfish Annual Report.

Eighty-one permits to fish in the Mau Zone have been issued since 1989, but only 37 of the permits were actually used. The turnover rate has been high, with only 38 percent of the 37 active vessels fishing in the Mau Zone for more than 2 years. A limited access program was established for the Mau Zone in 1999, and ten vessels are allowed to fish in the area under the Bottomfish FMP. Permits to fish in the Mau Zone are nontransferable and subject to a use-it-or-lose-it requirement. At present, there is no procedure for issuance of new Mau Zone limited access permits. Currently, there are 4 permitted bottomfish vessels fishing the Mau Zone.

A limited access program was established for the Hoomalu Zone in 1989. Since 1995, the number of vessels allowed to fish in the area has been set at seven. Permits to fish in the Hoomalu Zone are non-transferable and subject to a use-it-or-lose-it requirement. New Hoomalu Zone limited access permits are issued based on a point system. Since 1989, 17 permits to fish in the Hoomalu Zone have been issued, of which 15 have been used. In comparison to the Mau Zone, the Hoomalu Zone exhibits more continuity in participation, but the turnover has still been fairly high. Only about half of the active vessels have fished in the Hoomalu Zone for more than two years. Currently, there are four permitted bottomfish vessels active in the fishery.

Table 13 summarizes the number of trips taken per year in each of the Hawaii bottomfish fishing zones. In the Mau Zone, the largest number of trips occurred in 1994 and 1995 at nearly 100 in each year. From 1998 to 2002 the number of trips to this zone has averaged 49, although in 2002, 76 trips were made.

The number of trips to the Hoomalu Zone peaked in its inaugural year, 1988, and has only reached 50 trips once thereafter (1998). Between 1998 and 2002, the average number of trips made there is 38 per year.

Recorded (commercial) trips in the MHI peaked at 5,091 in 1989. Prior to 1979, there had never been a year with more than 2,000 trips. The MHI fishery peaked in the period 1983–1989, when the annual number of trips averaged 4,414. The highest number of MHI annual trips since then is 3,810 in 2000. The average number of MHI trips between 1998 and 2002 is 3024. The 2003 total, although incomplete, is the lowest in 25 years (see Figure 9).

Table 13: Number of Trips in the Hawaii Bottomfish Fishery, 1988–2003.

Year	Mau	Hoomalu	Total NWHI	MHI
1988	21	72	93	4,911
1989	22	28	50	5,091
1990	55	25	80	3,242
1991[1]	84	47	131	2,895
1992[1]	55	37	92	3,401
1993[1]	72	34	106	1,977

Year	Mau	Hoomalu	Total NWHI	MHI
1994[1]	99	41	140	2,333
1995[1]	97	33	130	2,031
1996[2]	81	26	107	2,780
1997[2]	53	38	91	3,158
1998[2]	39	50	89	3,023
1999[2]	30	48	78	2,970
2000[2]	47	36	83	3,810
2001[2,3]	55	41	87	2,761
2002[2,]	76	26	102	2,556
2003[2,4]	37	39	76	1,517
M				
SD				

Note. [1]NWHI data from combination NMFS and HDAR. [2]Data from HDAR. [3]2001 data are a combination of HDAR data sets. [4]Incomplete data. Source: WPRFMC 2005c, 2003 Bottomfish Annual Report.

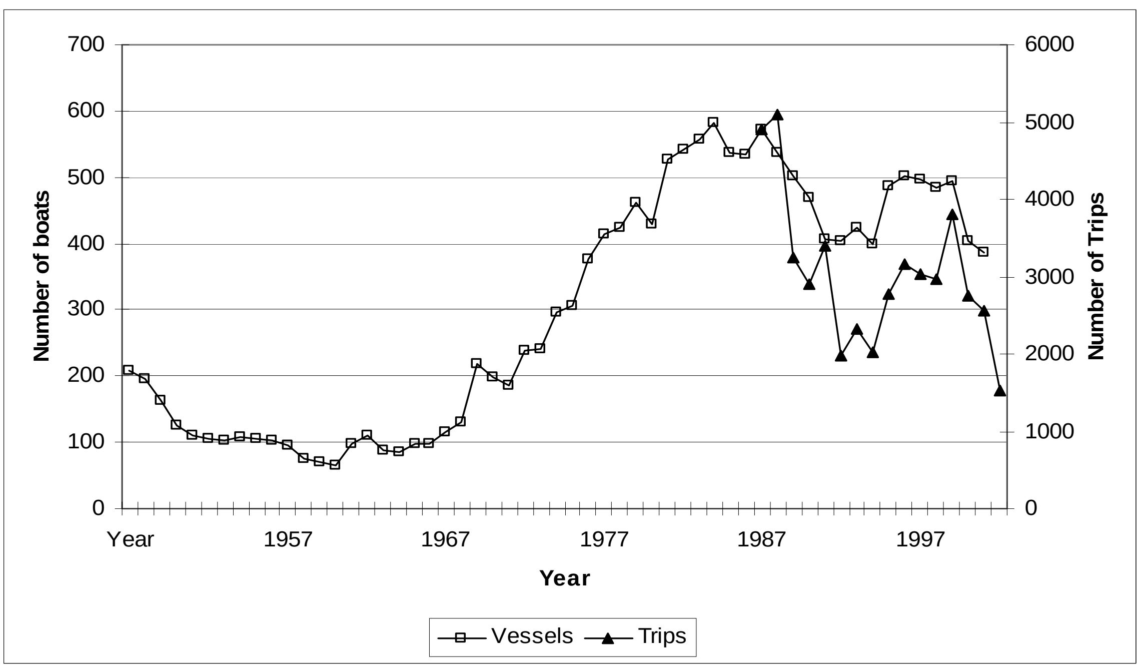


Figure 9. MHI Bottomfish Vessels and Trips by Year. Source: WPRFMC 2005c, Bottomfish 2003 Annual Report.

Table 14 summarizes the number of MHI bottomfish fishing trips by area. For the most recent years for which data are available there have been on average 445 trips to Penguin Bank, but only nine to Middle Bank.

Table 14: Summary of Number of Trips[1] by Area.

Zone Name	2000	2001	2002	2003
Hawaii (island) state water (0–2)	638	499	427	403
Hawaii (island) federal water	890	752	565	489
Hawaii (island) both	1,526	1,249	992	891
MMLK state water (0–2)	480	359	363	355
MMLK federal water	909	605	613	558
MMLK both	1,386	960	973	908
Penguin Bank federal water	480	377	496	426
MMLK plus 331 federal water	1,865	1,336	1,469	1,332
Oahu state water (0–2)	203	143	184	214
Oahu federal water	361	255	335	402
Oahu both	563	398	518	612
Kauai state water (0–2)	143	140	187	112
Kauai federal water	333	236	193	93
Kauai both	475	376	379	205
Middle Bank federal water	17	8	7	5

Note. MMLK (Maui, Molokai, Lanai, Kahoolawe) does not include Penguin Banks, until mentioned otherwise. [1] Trip/License by areas may not be additive because the fisherman may have fished in more than one area during a single trip. The more than one area per trip may be divided into state/federal or multiple areas within each broad destination. Trip = 1 day fished. Source: Kawamoto and Tao 2005.

Table 15 summarizes the number of participants using state and federal bottomfish fishing areas around the MHI. As reflected by the numbers of trips shown in Table 13, Penguin Bank is a highly popular area, used on average during the past 4 years by 61 license holders. In contrast, Middle Bank, much less accessible to smaller boats and those based farther south, was used on average by only about three license holders per year.

Table 15. Summary of Unique License Numbers[1] by Area.

Zone name	2000	2001	2002	2003
Hawaii (island) state water (0–2)	76	62	64	57
Hawaii (island) federal water	116	98	84	44
Hawaii (island) both	178	153	131	89
MMLK state water (0–2)	81	63	61	59
MMLK federal water	102	91	80	66
MMLK both	146	120	112	99
Penguin Bank federal water	77	58	59	50
MMLK plus 331 federal water	209	168	163	145
Oahu state water (0–2)	56	41	51	53
Oahu federal water	76	51	52	46
Oahu both	120	81	91	89
Kauai state water (0–2)	32	35	40	37
Kauai federal water	61	46	42	16
Kauai both	85	71	66	44
Middle Bank federal water	5	4	2	2

Note. MMLK (Maui, Molokai, Lanai, Kahoolawe) does not include Penguin Banks, until mentioned otherwise.

[1]Trip/License by areas may not be additive because the fisherman may have fished in more than one area during a single trip. The more than one area per trip may be divided into state/federal or multiple areas within each broad destination. Trip = 1 day fished. Source: Kawamoto and Tao 2005.

3.4.4.2 Landings

Only commercial landings data are available for the MHI fishery because the State of Hawaii does not require a saltwater recreational fishing license and there are no state or federal reporting requirements for recreational fishing in the waters around Hawaii. It is estimated that the recreational/subsistence catch in the MHI bottomfish fishery is about equal to the commercial catch (WPRFMC 1999). Charter boat operators are considered to be commercial fishermen under Hawaii statute and therefore are required to submit monthly catch reports. Consequently, charter boat catches are included in estimates of commercial landings.

Based on recent (1999 to 2003) landings data, commercial bottomfish catches in the MHI fishery represent approximately 60 percent of the total commercial bottomfish landings in Hawaii (WPRFMC 2003). If, as has been suggested, unreported noncommercial landings, virtually all of which are from the MHI, are approximately equal to the reported commercial landings from the MHI, it would mean that about 75 percent of Hawaii's bottomfish landings are from the MHI. The annual bottomfish landings in the MHI have been fairly stable for the past 10 years (Table 16), however, in the past 3 years landings have trended downward (Figure 10) reflecting a rather sharp drop in participation.

Table 16: Commercial Bottomfish Landings in the MHI and NWHI 1984–2003 (1,000 lbs).

Year	Mau	Hoomalu	Total NWHI	MHI[2]
1984	NA	NA	661	807
1985	NA	NA	922	763
1986	NA	NA	869	810
1987	NA	NA	1,015	783
1988	NA	NA	625	1,164
1989	118	184	303	1,006
1990	249	173	421	646
1991[1]	103	283	387	548
1992[1]	71	353	424	587
1993[1]	98	287	385	348
1994[1]	160	283	443	458
1995[1]	166	202	369	440
1996[1]	133	176	309	440
1997[1]	105	241	346	513
1998[1]	66	266	332	479
1999[2]	54	269	323	455
2000	49	213	262	497
2001	50	236	286	367
2002[4]	108	120	228	362
2003[3,4]	77	145	222	273
M	107.13	228.73	336.00	494.60
SD	53.89	63.03	235.53	233.77

Note. [1]NWHI data from combination NMFS and HDAR. 2. Data from HDAR. [3]Incomplete data. [4]MHI data incomplete. Source: WPFMC 2005c, 2003 Bottomfish Annual Report.

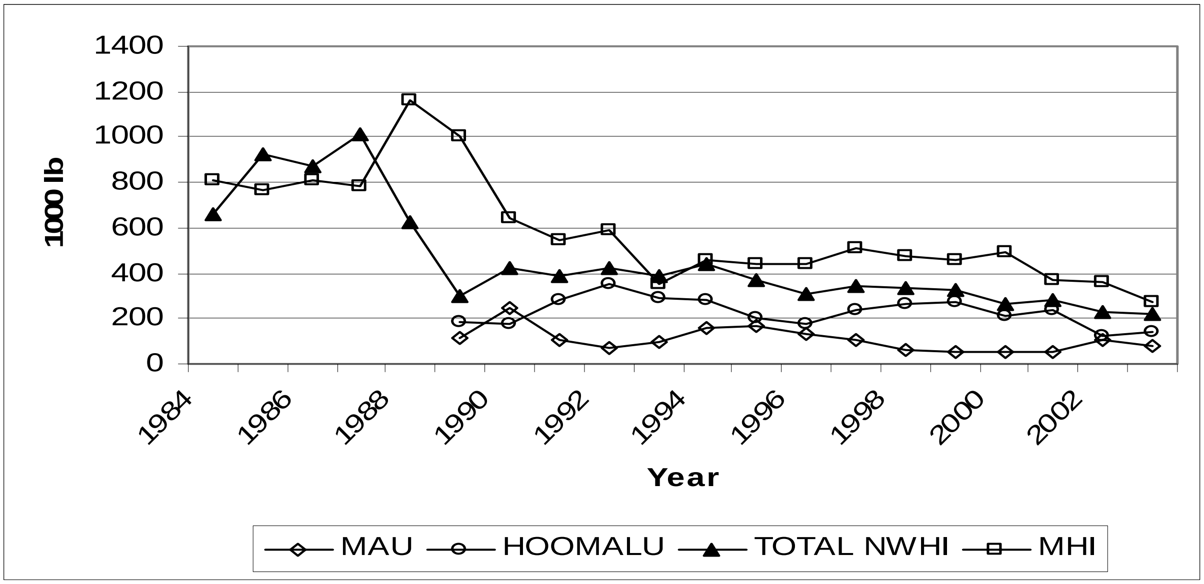


Figure 10: Commercial Bottomfish Landings in Hawaii by Year and Management Zone. Source: WPFMC 2005c, 2003 Bottomfish Annual Report.

Total NWHI bottomfish landings grew dramatically in the mid-1980s and then tailed off, stabilizing in the 1990s at a level slightly below the MHI bottomfish landings (Table 16).

The ex-vessel sales of BMUS in 2002 clearly show the substantial effects of changes in fishing strategy and participation in the fishery. The overall vessel sales reports indicate that the total NWHI BMUS landings were substantially lower in 2002 (Table 16). A single vessel dropped out of each management zone with varying effects on the overall zone landings. Although the Mau Zone lost a vessel, there were some vessels that did increase their targeting of bottomfish contrary to their usual pelagic species/mixed species targeting strategy. The BMUS landings in the Mau Zone increased by 116 percent (Table 16) while the number of trips increased by 38 percent. The Hoomalu Zone lost a single participating highliner vessel and the effects of that loss were realized in the 49 percent decrease in landings and the 36 percent decrease in the number of trips from that zone.

In 2003, the number of vessels fishing in the Mau and Hoomalu Zones remained constant from the previous year, but the number of trips taken changed substantially in both zones. In 2003, Mau Zone trips decreased by 51 percent, while Hoomalu Zone trips increased by 50 percent. These shifts in effort resulted in a 29 percent decrease in Mau Zone landings and a 21 percent increase in Hoomalu Zone landings.

In the MHI, landings peaked in the 1988 to 1989 period, coincident with the historical maximum number of recorded trips. In recent years, landings have trended downward, with the 2003 landings being the lowest since 1970, reflecting the 25-year low in number of trips.

Table 17 summarizes NWHI BMUS landings by species. From 1991 through 1998, ōpakapaka landings were greater than those of any other species in the NWHI. From 1999 through 2001, however, onaga landings were higher than those of any other species. For the two most recent years, uku landings have predominated. For comparison, Table 18 summarizes MHI BMUS landings by species over the same period. Opakapaka landings were greater than those of any other species in every year.

Table 19 summarizes bottomfish landings from areas around the MHI. Reflecting the pattern observed for effort and participation, the landings for Penguin Bank are substantial, but those for Middle Bank are the lowest for any of the areas. The Penguin Bank landings have averaged nearly 60,000 pounds annually, but there has been a general downward trend over the past four years.

Table 17: NWHI BMUS Landings by Species (1,000 lbs).

Species	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Opakapaka	79	86	145	158	145	105	79	109	87	77	53	67	36	20
Onaga	21	46	23	40	42	53	30	55	48	93	92	73	54	50
Ehu	25	20	8	11	15	8	17	15	17	17	13	14	10	10
Hapụupụu	85	59	57	59	68	54	49	57	70	59	23	31	29	36
Butaguchi	103	75	79	64	61	47	46	51	38	28	29	32	29	20
Uku	77	69	86	33	78	75	62	37	55	36	43	59	60	82
Other BMUS	23	22	18	19	27	17	25	19	15	11	9	12	11	6

Source: WPRFMC 2005c, 2003 Bottomfish Annual Report.

Table 18: MHI BMUS Landings by Species (1,000 lbs).

Species	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Opakapaka	147	134	178	103	158	137	171	172	168	155	179	108	108	91
Onaga	108	89	72	43	52	49	81	83	69	72	89	54	67	50
Ehu	34	27	29	18	18	21	34	31	28	23	35	22	17	11
Hapụupụu	15	14	14	9	13	14	14	17	14	12	19	12	8	7
Uku	109	90	88	61	72	59	64	81	74	108	96	66	56	36

Source: WPRFMC 2005c, 2003 Bottomfish Annual Report.

Table 19: Summary of Pounds Caught by Area.

Zone Name	2000	2001	2002	2003
Hawaii (island) state water (0–2)	31,713	21,567	16,689	22,310
Hawaii (island) federal water	47,422	39,450	29,302	24,191
Hawaii (island) both	79,135	61,017	45,991	46,501
MMLK state water (0–2)	46,304	31,909	37,430	38,616
MMLK federal water	105,527	61,962	69,338	61,407
MMLK both	151,831	93,871	106,768	100,023
Penguin Bank federal water	77,910	52,391	62,913	45,459
MMLK plus 331 federal water	229,741	146,262	169,681	145,482
Oahu state water (0–2)	6,014	4,621	6,933	9,768
Oahu federal water	31,190	17,097	19,066	19,877
Oahu both	37,204	21,718	25,999	29,645
Kauai State water (0–2)	13,203	10,082	10,665	7,272
Kauai federal water	22,028	25,676	28,822	22,104
Kauai both	35,231	35,758	39,487	29,376
Middle Bank federal water	Confidential Data[1]			

Note. MMLK (Maui, Molokai, Lanai, Kahoolawe) does not include Penguin Banks, until mentioned otherwise. [1]Trip/License by areas may not be additive because the fisherman may have fished in more than one area during a single trip. The more than one area per trip may be divided into state/federal or multiple areas within each broad destination. Trip = 1 day fished. Source: Kawamoto and Tao, 2005.

To illustrate the importance of Penguin Bank and Middle Bank to the MHI bottomfish fishery, Figure 11 plots landings of the seven major bottomfish species from those two areas as a proportion of the total MHI landings of those species. That proportion has varied from a low of 12 percent in 1999 to a high of 25 percent in 1994. The proportion was 19 percent in 2004.

There is an annual cycle of landings from Penguin and Middle Banks, as can be seen in Figure 12. Landings peak in December and January and are lowest in June and July.

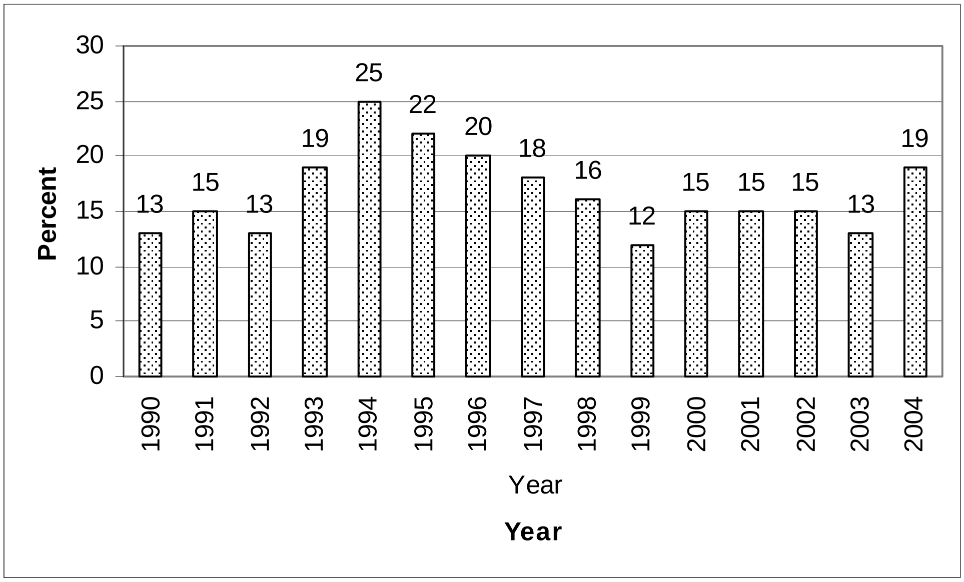


Figure 11: Landings from Penguin and Middle Banks as a Percentage of Total MHI Landings (Deep 7 Species). Source: Kawamoto and Tao, 2005.

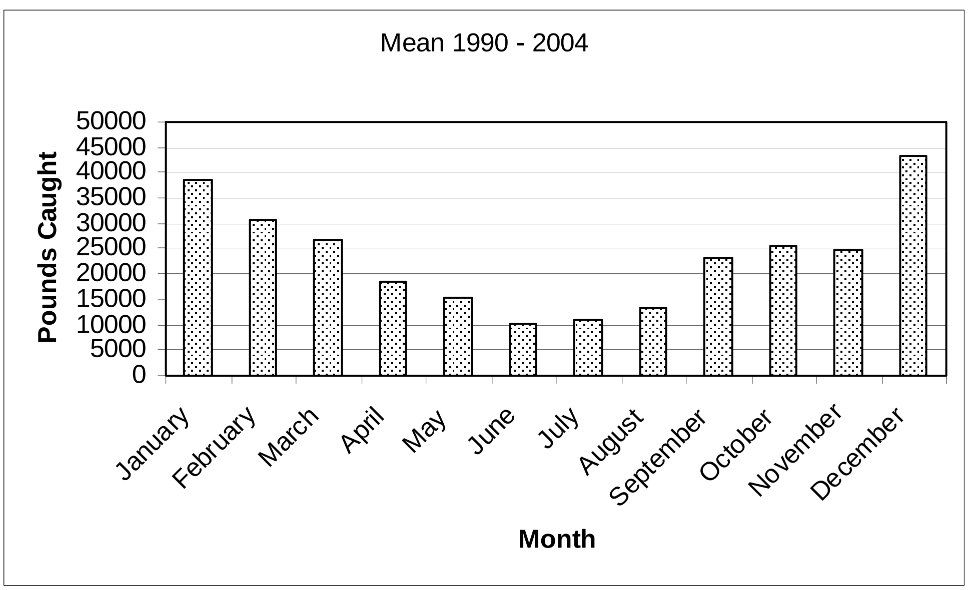


Figure 12: Monthly Landings From Penguin and Middle Banks. Source: Kawamoto and Tao, 2005.

The following tables present additional, newer analyses of landings by species and landings by month in the Hawaii bottomfish fishing zones. Tables 20 to 22 and Figure 13 show the species composition of the three bottomfish management zones in the Hawaiian Islands archipelago between 1996 and 2004. Between five and seven species form over 90 percent of catch in each management area. In the MHI, catches are dominated by opakapaka, onaga, uku, taape, papio/ulua, ehu, and kalekale, with opakapaka, onaga and uku accounting for almost two thirds of landings. Another distinguishing feature of MHI bottomfish catches is the relatively large amount of ta’ape, which forms over 13 percent of landings. Ta’ape is found in only relatively small quantities in landings from the Mau Zone and is not recorded in Hoomalu Zone landings.

Uku or the green snapper, *Aprion virescens*, is also a major component of MHI bottomfish catches, and is the most dominant feature of bottomfish catches from the Mau Zone, where it forms almost 40 percent of the catch. The other dominant species in Mau Zone catches include butaguchi, opakapaka, hapuupuu, onaga, and ehu. Butaguchi, opakapaka, and hapuupuu all make similar contributions to the catch, while onaga forms less than 10 percent of catches. In the neighboring Hoomalu Zone, onaga, and opakapaka make up just over half of the catches, with the balance of the catch formed principally by hapuupuu, uku, and butaguchi.

These catch composition data indicate quite clearly that there are major differences in the catch composition between the three zones. Opakapaka and onaga account for about half the landings from the MHI and Hoomalu Zone but are a much smaller fraction (21 percent) of the Mau Zone landings, which are dominated by shallow water bottomfish species, particularly uku and butaguchi.

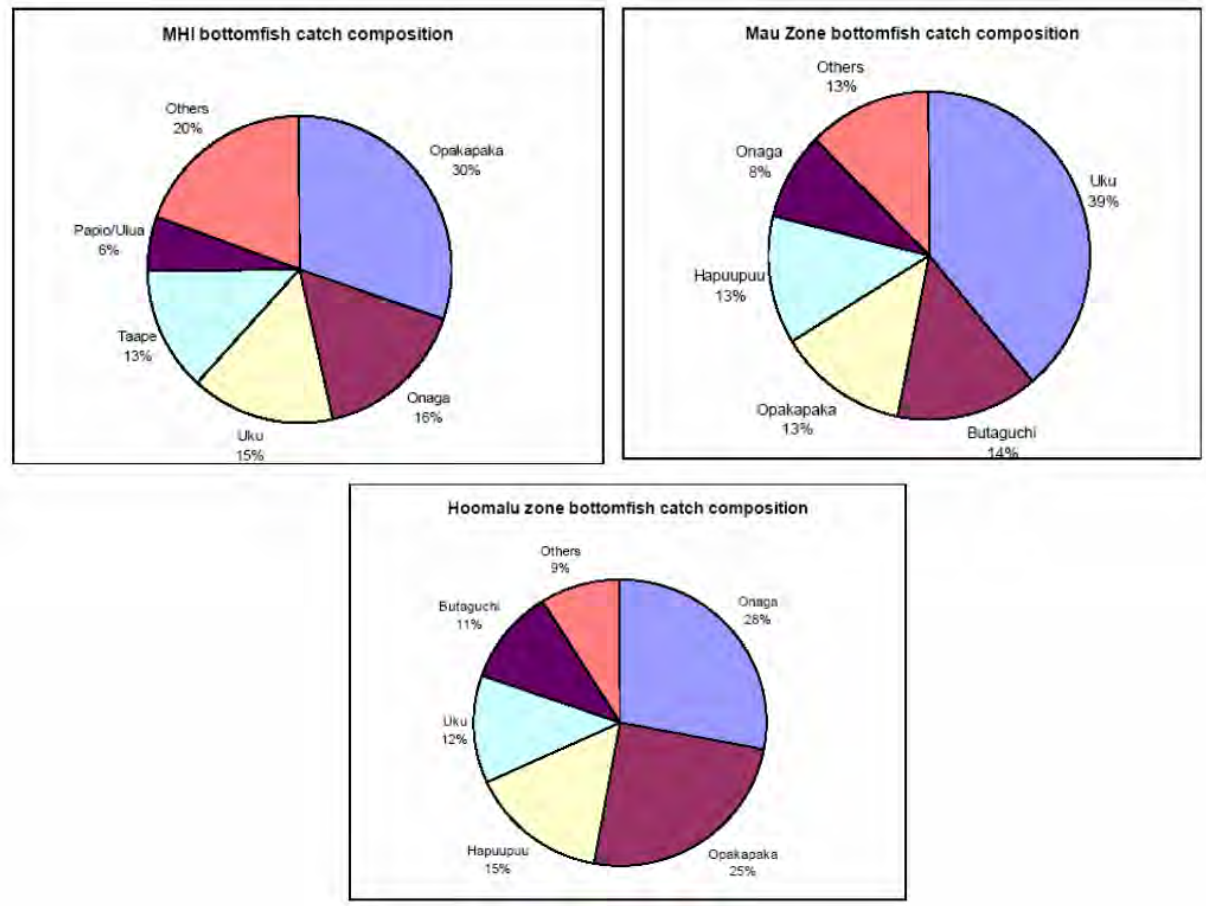


Figure 13: Average Species Composition (1996–2004) of Bottomfish Catches from the Three Bottomfish Management Zones in the Hawaii Archipelago. Source: Kawamoto and Gonzales 2005.

Table 20: MHI BMUS Pounds Caught, Totals by Species and Year, 1996–2004.

MHI Zone	Year								
Species Name	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Hapuupuu	11,466	14,215	11,346	10,106	16,183	11,105	8,411	10,208	8018
Kahala	5,526	12,108	21,805	17,599	22,573	13,823	11,336	4,886	6952
Kalekale	21,788	21,252	19,886	11,190	16,659	11,759	11,451	9,922	7785
Opakapaka	148,730	145,807	141,958	129,155	149,879	100,003	108,917	115,719	102168
Uku	53,309	67,976	61,105	89,834	80,036	57,469	56,930	44,254	67776
Ehu	28,286	25,798	23,728	19,429	29,522	20,911	17,441	15,489	22178
Onaga	67,550	69,145	58,325	60,981	74,531	54,993	68,981	71,560	85072
Papio/Ulua	35,579	41,330	40,770	25,039	23,409	24,585	20,605	1,046	1765
Lehi	8,839	12,367	8,647	9,859	10,834	10,427	9,536	8,573	6673
Gindai	3,143	2,812	3,346	2,390	3,653	3,127	2,129	2,039	2104
Taape	44,195	85,491	74,851	70,073	55,041	47,551	39,399	37,895	43528
Armorhead	0	0	0	0	0	0	0	0	0
Butaguchi	3,261	5,926	1,944	1,796	2,653	1,737	1,649	1,632	1341
Gunkan ulua	52	192	315	12	73	123	421	1,072	1038
White ulua	6,213	2,204	3,717	2,977	4,046	4,202	4114	12,255	11087
Yellow-tail kali	0	0	0	0	0	5	1	0	44

Note. Pounds caught are from adjusted values whenever possible. Source: Kawamoto and Gonzales 2005.

Table 21: Mau Zone BMUS Pounds Caught, total by Species and Year, 1996–2004.

Mau Zone	Year								
Species Name	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Hapuupuu	20,166	13,838	7,517	5,777	4,657	4,266	17,110	17,376	11,824
Kahala	205	0	480	1,206	2,024	387	1,285	986	1,518
Kalekale	7,729	3,985	1,630	1,257	2,638	2,016	3,099	1,310	872
Opakapaka	15,632	26,586	9,428	7,918	6,987	4,182	15,405	6,372	10,609
Uku	47,610	24,621	32,152	27,144	13,033	19,086	44,679	53,177	46,769
Ehu	12,238	4,070	3,091	4,231	5,159	6,083	6,702	3,269	2,497
Onaga	10,865	17,301	1,835	3,969	3,462	3,824	9,725	6,107	9,573
Papio/Ulua	15	0	12	0	0	0	0	0	0
Lehi	201	47	43	36	575	25	26	55	0
Gindai	3,487	1,036	613	1,109	841	608	1,400	885	915
Taape	40	9	2	5	17	47	24	1	5
Armorhead	0	0	0	0	0	0	0	0	0
Butaguchi	25,289	16,461	9,113	7,229	14,365	8,328	10,391	8,741	11,558
Gunkan ulua	872	547	450	248	183	224	1169	420	283
White ulua	818	500	237	129	298	551	785	21	140
Yellow-tail Kali	49	0	25	6	0	0	6	8	11

Note. Pounds caught are from adjusted values whenever possible. Source: Kawamoto and Gonzales 2005.

Table 22: Hoomalu Zone BMUS Pounds Caught, Totals by Species and Year, 1996–2004.

Hoomalu Zone	Year								
Species Name	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Hapuupuu	21,892	44,490	65,313	56,018	20,595	21,107	12,670	19,800	23,089
Kahala	30	48	0	100	0	320	0	0	2,017
Kalekale	1,708	3,913	3,710	3,201	1,563	1,499	1,053	1,149	1,039
Opakapaka	61,568	85,465	75,537	71,841	50,487	52,901	22,846	159,60	21,389
Uku	16,328	14,853	23,040	13,758	29,824	36,491	14,861	41,721	35,872
Ehu	6,163	11,230	14,988	14,161	8,487	8,372	3,836	7,579	7,443
Onaga	18,997	38,296	49,851	94,594	91,354	70,630	47,204	48,379	62,463
Papio/Ulua	0	0	0	0	0	0	0	7	0
Lehi	0	17	0	0	4	0	11	0	0
Gindai	1,684	4,289	4,501	2,860	1,153	1,362	1,546	1,982	2,384
Taape	0	0	0	0	0	0	0	0	0
Armorhead	0	0	12	11	8	0	0	0	4
Butaguchi	23,515	36,817	30,257	22,726	21,388	19,432	20,325	14,614	13,033
Gunkan ulua	0	0	0	0	377	0	0	0	11
White ulua	11,646	5,244	6,523	2,638	1,624	5,249	2,939	507	549
Yellow-tail Kali	0	0	0	0	0	0	0	0	0

Note. Pounds caught are from adjusted values whenever possible. Source: Kawamoto and Gonzales, 2005.

Table 23: MHI BMUS Pounds Caught, Totals by Month and Year, 1996–2004.

MHI Zone					Year				
Month	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
January	53,913	57,773	83,724	41,694	36,722	53,068	41,446	36,027	44,366
February	31,793	49,515	50,500	38,532	76,062	39,302	30,018	29,006	27,899
March	39,422	44,093	59,069	23,414	41,962	39,919	31,590	43,604	18,747
April	27,485	49,829	21,049	23,257	21,017	15,107	41,743	22,804	24,408
May	33,442	39,580	24,274	43,720	46,075	36,673	35,601	26,174	24,551
June	29,063	19,230	27,453	41,339	45,679	22,055	20,026	28,205	19,606
July	21,726	25,949	28,874	32,397	19,217	22,966	20,091	10,465	24,401
August	36,038	35,942	32,975	27,990	26,018	16,679	16,034	14,445	24,009
September	37,985	43,304	27,091	35,115	42,427	18,703	37,909	30,453	32,537
October	42,197	39,819	32,598	41,357	24,360	26,998	17,953	38,647	31,022
November	36,172	45,343	30,030	33,580	26,445	37,458	30,072	19,419	43,451
December	48,701	56,246	54,106	68,045	83,108	32,892	38,838	37,301	52,532

Note. Pounds caught are from adjusted values whenever possible. Source: Kawamoto and Gonzales, 2005.

Table 24: Mau Zone BMUS Pounds Caught, Totals by Month and Year, 1996–2004.

Mau Zone					Year				
Month	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
January	13,330	15,195	7,792	3,331	2,158	1,060	1,218	5,074	6,348
February	12,349	21,853	11,791	4,411	1,116	3,009	6,840	9,152	10,069
March	11,729	10,340	10,596	3,918	0	3,528	14,170	11,886	7,539
April	11,712	18,329	1,871	498	665	1,675	10,558	4,901	10,068
May	12,011	6,527	896	5,337	4,038	4,495	8,161	11,646	15,143
June	19,154	9,420	3,238	0	8,215	2,665	3,913	15,981	8,674
July	13,399	8,206	1,567	4,832	10,243	7,180	12,190	2,658	11,094
August	11,667	5,022	2,576	1,877	13,205	8,954	10,778	14,010	3,608
September	15,032	602	2,563	11,345	2,981	9,547	10,516	5,667	6,782
October	9,606	1,580	13,790	9,910	3,215	1,547	15,255	5,510	8,874
November	5,007	4,986	6,065	7,188	2,460	4,620	10,865	7,925	3,651
December	10,220	6,941	3,883	7,617	5,943	1,347	7,342	4,318	4,724

Note. Pounds caught are from adjusted values whenever possible. Source: Kawamoto and Gonzales, 2005.

Table 25: Hoomalu Zone BMUS Pounds Caught, Totals by Month and Year, 1996–2004.

Hoomalu Zone	Year								
Month	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
January	18,379	17,395	16,112	28,454	15,890	31,447	7,455	2,570	6,551
February	8,195	10,309	17,021	21,406	20,223	21,801	10,079	16,918	6,659
March	9,074	24,540	21,509	29,789	28,657	14,234	16,061	9,062	2,220
April	14,631	25,114	18,960	24,318	21,207	19,509	6,377	21,553	18,506
May	9,630	21,267	18,457	19,028	22,054	16,522	9,621	10,101	15,688
June	14,622	11,131	20,377	30,530	13,515	17,458	8,545	13,424	14,973
July	14,182	19,297	24,165	18,433	10,188	18,678	5,178	14,123	19,954
August	11,279	20,444	23,197	26,220	20,905	12,680	10,952	11,041	17,033
September	8,791	21,655	31,516	19,868	16,180	15,042	4,538	10,448	7,413
October	22,489	25,946	35,480	16,116	22,802	16,857	16,049	11,222	22,711
November	9,821	27,014	21,265	22,922	17,867	13,801	12,384	13,630	20,084
December	22,438	20,550	25,673	24,824	17,376	19,334	20,052	17,606	17,501

Note. Pounds caught are from adjusted values whenever possible. Source: Kawamoto and Gonzales, 2005.

Table 26: Summary of Pounds Caught (Deep 7 Species) in the MHI by Month, 1990–2003.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
January	26,635	45,411	57,226	35,839	41,351	54,854	40,228	38,597	59,489	28,136	23,739	36,585	30,199	29918	32135
February	36,789	35,152	28,224	22,323	34,868	49,352	24,176	29,573	29,824	22,689	60,214	22,275	19,855	21031	21453
March	39,815	14,702	33,345	16,456	29,416	32,402	29,735	26,097	37,486	13,542	32,340	24,748	22,254	35563	12902
April	33,472	12,391	39,069	10,926	15,466	18,240	18,833	28,920	8,857	10,426	13,634	6,837	29,032	15322	16534
May	15,177	13,164	23,527	11,559	12,226	16,317	15,277	20,107	9,742	16,859	19,573	16,267	12,519	14874	12286
June	9,797	11,498	11,599	9,717	10,848	10,618	11,131	5,992	9,262	10,368	14,996	9,098	3,250	15,958	6734
July	28,332	19,155	14,437	10,922	14,068	10176	10,636	10,597	6,621	7,807	5,377	9,484	4,232	4,636	9216
August	27,276	17,068	11,065	17,597	21,840	8,738	19,617	1,5845	11,107	8,955	9,208	7,489	7,860	8,292	8577
September	27,078	27,643	17,595	33,102	35,029	26,225	26,579	20,317	15,341	20,368	24,220	8,736	26,709	21,294	15494
October	28,574	43,493	35,785	29,622	37,287	15,131	29,794	22,477	21,199	26,597	15,341	18,626	12,328	28,557	19691
November	37,586	29,607	23,848	22,640	14,448	28,774	26,357	30,477	17,696	24,217	17,914	26,829	24,855	12,043	35235
December	43,733	31,661	44,500	49,247	52,030	59,810	37,439	42,397	40,612	53,146	64,705	25,351	33,773	26,022	43741
Summary	354,264	300,945	340,220	269,950	318,877	330,637	289,802	291,396	267,236	243,110	301,261	212,325	226,866	233,510	233998

Note. Deep 7 BMUS species list does not include uku (*Aprion virescens*). 1998 is the year that State of Hawaii instituted bottomfish species area closures and recreational bottomfish bag limits. Data sets used were all from the most recent HDAR data received in October 2005. Source: Kawamoto et al. 2005.

Table 27: Summary of Pounds Caught (Deep 7 Species) in MHI Federal Jurisdiction by Month, 1990–2004.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
January	5,409	6,933	5,481	7,461	7,352	12,509	11,801	7,263	16,711	3,649	3,441	6,099	4,284	3,799	5,763
February	4,800	5,822	4,497	3,742	8,978	8,906	6,348	5,517	5,147	2,197	12,468	5,270	3,600	2,023	3,003
March	5,662	1,449	4,895	3,924	7,778	7,975	6,124	2,882	5,458	1,193	7,955	6,043	3,083	5,310	457
April	4,717	3,266	4,760	1,607	3,882	6,615	4,643	4,770	1,313	1,377	2,053	1,325	4,503	1,019	1,328
May	834	3,264	3,277	1,825	3,807	6,025	1,631	3,997	1,166	2,510	713	2,073	2,020	566	2,641
June	1,049	2,048	1,606	1,317	3,993	2,746	1,759	1,538	372	997	929	747	747	2,033	0
July	2,023	2,693	1,944	1,289	7,271	2,124	1,599	2,869	402	1164	398	1240	216	104	163
August	3,670	2,470	1,114	3,800	6,381	1,985	1,924	3,198	1,099	988	194	1039	245	227	386
September	4,012	1,661	1,447	5,154	8,341	5,996	2,509	6,099	1,417	1,378	3,195	816	4,166	3,405	2,061
October	3,923	6,690	4,935	7,096	7,816	4,252	7,481	5,156	3,623	4,030	2,157	1,848	2,024	5,718	5,969
November	5,440	5,994	3,895	4,528	4,008	3,078	6,511	3,812	2,866	1,280	1,341	3,076	3,905	1,796	11,021
December	6,129	3,820	5,108	10,141	11,259	10,081	5,485	5,031	3,685	8,096	11,082	3,280	5,433	4,138	12,328
Summary	47,668	46,110	42,959	51,884	80,866	72,292	57,815	52,132	43,259	28,859	45,926	32,856	34,226	30,138	45,120

Note. Deep 7 BMUS species list does not include uku (*Aprion virescens*). 1998 is the year that State of Hawaii instituted bottomfish species area closures and recreational bottomfish bag limits. Source: Kawamoto et al. 2005.

Table 28: Federal Area Pounds Caught as Percentage of the Total Deep 7 Species Pounds Caught.

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
January	20%	15%	10%	21%	18%	23%	29%	19%	28%	13%	14%	17%	14%	13%	18%
February	13%	17%	16%	17%	26%	18%	26%	19%	17%	10%	21%	24%	18%	10%	14%
March	14%	10%	15%	24%	26%	25%	21%	11%	15%	9%	25%	24%	14%	15%	4%
April	14%	26%	12%	15%	25%	36%	25%	16%	15%	13%	15%	19%	16%	7%	8%
May	5%	25%	14%	16%	31%	37%	11%	20%	12%	15%	4%	13%	16%	4%	21%
June	11%	18%	14%	14%	37%	26%	16%	26%	4%	10%	6%	8%	23%	13%	0%
July	7%	14%	13%	12%	52%	21%	15%	27%	6%	15%	7%	13%	5%	2%	2%
August	13%	14%	10%	22%	29%	23%	10%	20%	10%	11%	2%	14%	3%	3%	5%
September	15%	6%	8%	16%	24%	23%	9%	30%	9%	7%	13%	9%	16%	16%	13%
October	14%	15%	14%	24%	21%	28%	25%	23%	17%	15%	14%	10%	16%	20%	30%
November	14%	20%	16%	20%	28%	11%	25%	13%	16%	5%	7%	11%	16%	15%	31%
December	14%	12%	11%	21%	22%	17%	15%	12%	9%	15%	17%	13%	16%	16%	28%
Summary	**13%**	**15%**	**13%**	**19%**	**25%**	**22%**	**20%**	**18%**	**16%**	**12%**	**15%**	**15%**	**15%**	**13%**	**19%**

Note. Deep 7 BMUS species list does not include uku (*Aprion virescens*). 1998 is the year that State of Hawaii instituted bottomfish species area closures and recreational bottomfish bag limits. Table data are expressed percentages of pounds caught, $[(PB + MB)/MHI] \times 100$. Source: Kawamoto et al. 2005.

Table 29: Pounds of Deep 7 Species Caught at Penguin Bank by Month, 1990–2004.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
January	5,409	6,933	5,481	7,088	7,352	11,533	11,759	6,476	16,711	3,649	3,441	6,099	4,284	3,799	5763
February	4,493	5,805	2,759	3,742	8,909	8,417	5,784	5,499	5,147	2,197	12,359	5,270	3,600	2,023	2955
March	5,662	1,449	3,806	2,458	7,717	7,683	5,957	2,882	5,458	1,193	7,352	6,043	3,083	5,310	457
April	4,717	3,225	4,714	1,607	3,178	5,927	4,619	4,770	1,313	1,209	2,053	1,322	4,503	1,019	1328
May	834	3,160	3,277	1,816	3,558	3,014	1,631	3,949	1,166	2,510	713	2,073	2,020	566	1890
June	1,049	1,139	1,606	1,317	3,080	2,022	1,759	1,285	372	997	603	744	606	2,033	0
July	2,017	2,684	884	1,289	5,483	1,375	1,599	2,252	402	1,164	355	1236	216	104	152
August	2,284	2,222	563	3,800	4,714	1,985	1,924	3,198	1,099	988	194	1039	245	227	386
September	3,775	1,639	874	5,154	7,136	5,735	2,446	6,099	1,417	1,378	2,026	775	4,166	3,359	2061
October	3,923	6,690	4,505	6,939	6,792	4,252	7,481	5,156	3,623	4,030	1,414	1,840	2,024	5,714	5969
November	5,408	5,688	3,874	4,528	2,877	3,014	5,746	3,812	2,866	1,280	813	3,076	3,905	1,796	11021
December	6,129	3,727	4,896	9,806	10,954	9,069	5,455	5,031	3,685	8,096	10,943	3,275	5,433	4,061	12328

Note. Deep 7 BMUS species list does not include uku (*Aprion virescens*). 1998 is the year that State of Hawaii instituted bottomfish species area closures and recreational bottomfish bag limits. Area 331 is the only area designated in the State statistical reporting area as Penguin Bank. Data sets used were all from the most recent HDAR data received in October 2005.Source: Kawamoto et al. 2005.

Table 30: Pounds of Deep 7 Species Caught at Middle Bank by Month, 1990–2004.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
January	0	0	0	373	0	976	42	787	0	0	0	0	0	0	0
February	307	17	1,738	0	69	489	564	18	0	0	109	0	0	0	48
March	0	0	1,089	1,466	61	292	167	0	0	0	603	0	0	0	0
April	0	41	46	0	704	688	24	0	0	168	0	3	0	0	0
May	0	104	0	9	249	3,011	0	48	0	0	0	0	0	0	751
June	0	909	0	0	913	724	0	253	0	0	326	3	141	0	0
July	6	9	1,060	0	1,788	749	0	617	0	0	43	4	0	0	11
August	1,386	248	551	0	1,667	0	0	0	0	0	0	0	0	0	0
September	237	22	573	0	1,205	261	63	0	0	0	1169	41	0	46	0
October	0	0	430	157	1,024	0	0	0	0	0	743	8	0	4	0
November	32	306	21	0	1,131	64	765	0	0	0	528	0	0	0	0
December	0	93	212	335	305	1,012	30	0	0	0	139	5	0	77	0

Note: Deep 7 BMUS species list does not include uku (*Aprion virescens*). 1998 is the year that State of Hawaii instituted bottomfish species area closures and recreational bottomfish bag limits. Areas denoted as Middle Bank are 578, 579, 593, and 594. Data sets used were all from the most recent HDAR data received in October 2005. Source: Kawamoto et al. 2005.

Tables 22 to 24 and Figure 14 show the monthly landings of BMUS from the three management zones in the Hawaii Archipelago. There is a clear difference in the seasonal pattern of landings between the MHI and the two zones in the NWHI. MHI bottomfish landings peak between November and March, which reflects the demand for red snappers over the holiday season between Thanksgiving and the New Year period, which also includes the Chinese and Vietnamese new years. On the other hand, landings from the MHI are lowest in the summer months, between June and August, presumably as MHI fishermen take vacations at this time. By contrast, both the Mau and Hoomalu Zone monthly landings do not show much of a seasonal pattern, being relatively steady throughout the year, with the suggestion of a response from the Mau Zone to offset the mid-year trough in the MHI production.

Tables 25 to 30 summarize data on the Deep 7 bottomfish species complex in order to ascertain the impacts of closing those waters under federal jurisdiction in the MHI. This includes primarily penguin Bank and Middle Bank, most of which lie beyond the 3-mile limit under the jurisdiction of the State of Hawaii. Not surprisingly, Figure 15 shows that the seasonal pattern of landings observed for the MHI in Figure 14 is similar for the Deep 7 bottomfish complex. The monthly percentage of the MHI bottomfish landings formed by catches from federal waters ranges on average from 13 to 18 percent (Figure 16) with an overall average of 17 percent.

The average monthly pattern of landings of Deep 7 species from the two principal bottom-fishing grounds in federal waters are shown in Figure 17. The monthly landings at Penguin Bank reflect the trend for the MHI as a whole but with a much sharper decline during the summer months lasting from April to September. The data for the Deep 7 landings at Middle Bank are much patchier, with many months in different years with no landings from this fishing ground. However, the average trend suggests that the pattern of landings from this fishing ground is more or less the converse of the typical MHI pattern, with landings peaking between May and October.

In summary, the patterns for the MHI show that landings as a whole decline in the late spring-summer period, presumably as a result of less fishing activity as fishermen take vacations or possibly perform maintenance on their vessels. Market demand for bottomfish in this period does not appear to decline, and is compensated by production from the two NWHI fishing grounds, which are far less seasonal in their production, and possibly by an increase in production, at least in some years from Middle Bank in the MHI. Moreover, this seasonal production pattern is also reflected in bottomfish imports into the State of Hawaii, which show a response to the MHI production decline, with peaks in imports between June and September.

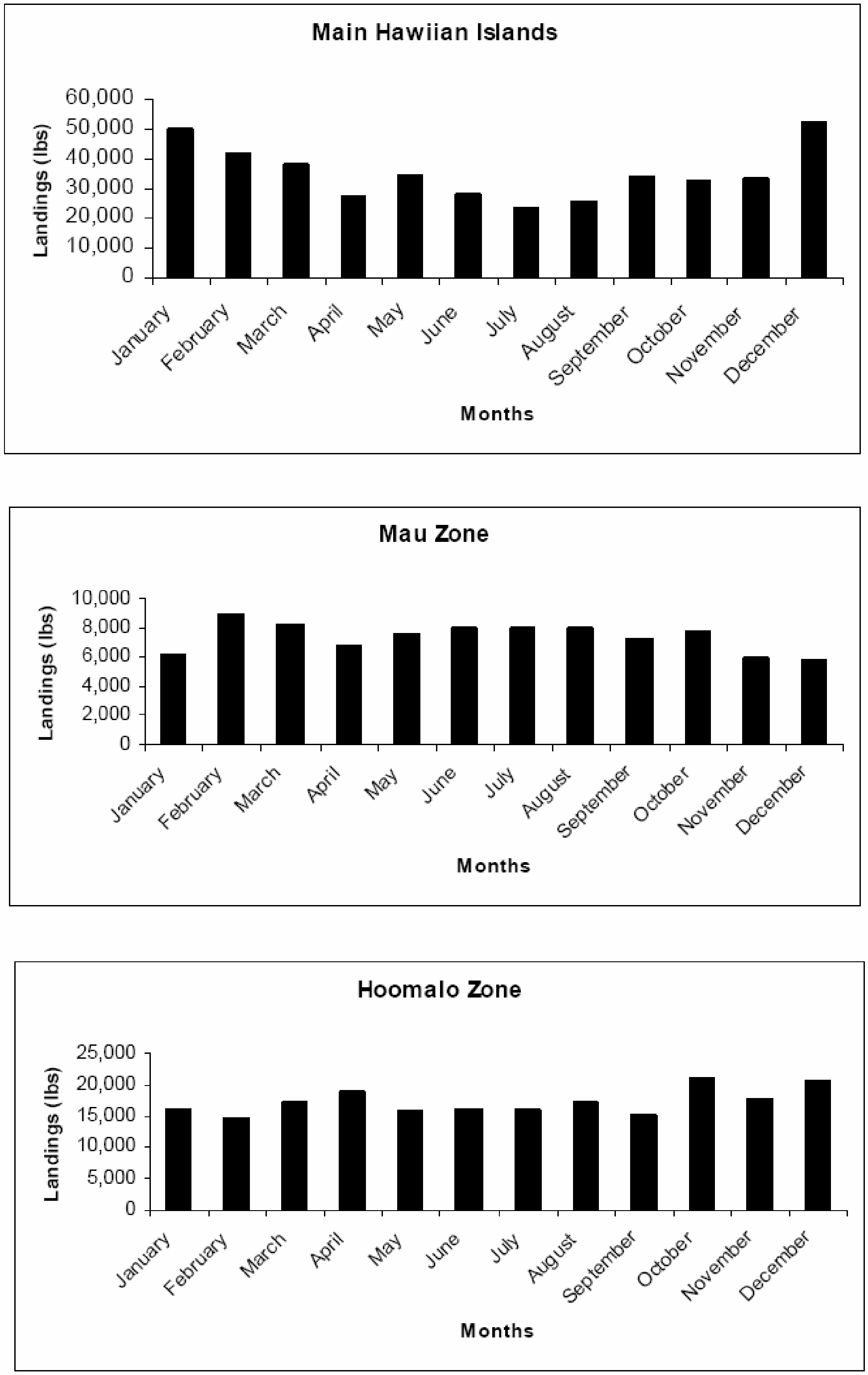


Figure 14: Average Monthly Landings between 1996 and 2004 for the Three Bottomfish Management Areas in the Hawaii Archipelago. Source: Kawamoto and Gonzales 2005.

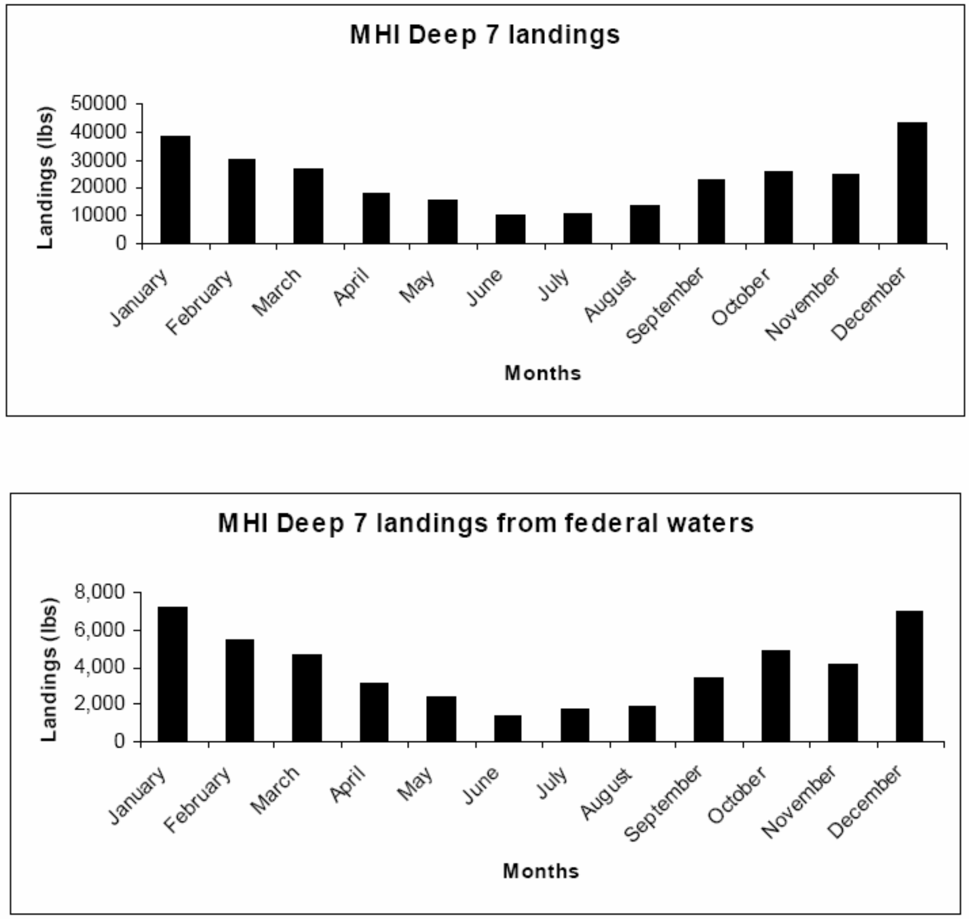


Figure 15: Average Monthly Landings of Deep 7 Species From MHI and From Federal Waters in the MHI. Source: Kawamoto et al. 2005.

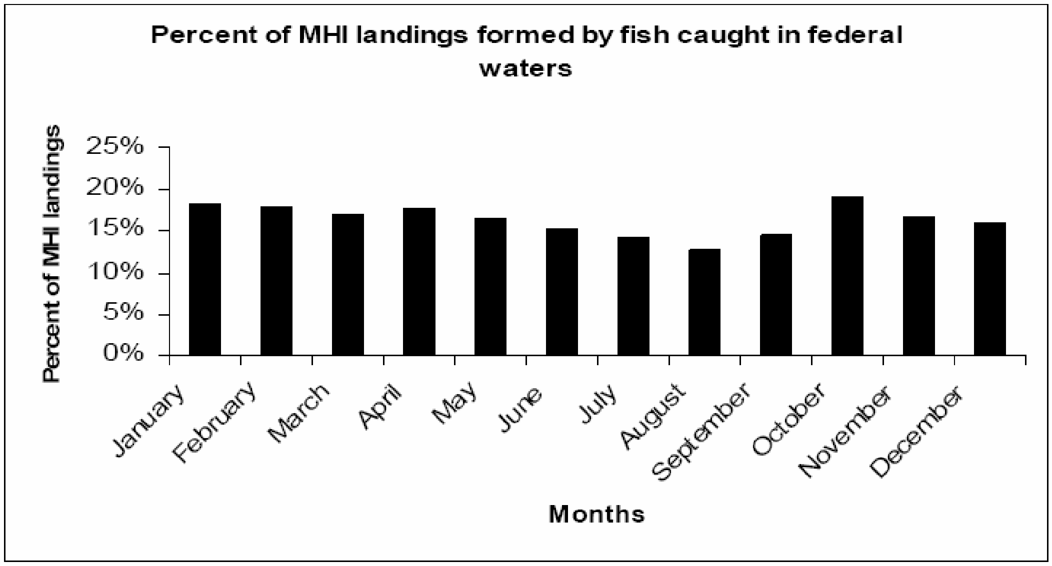
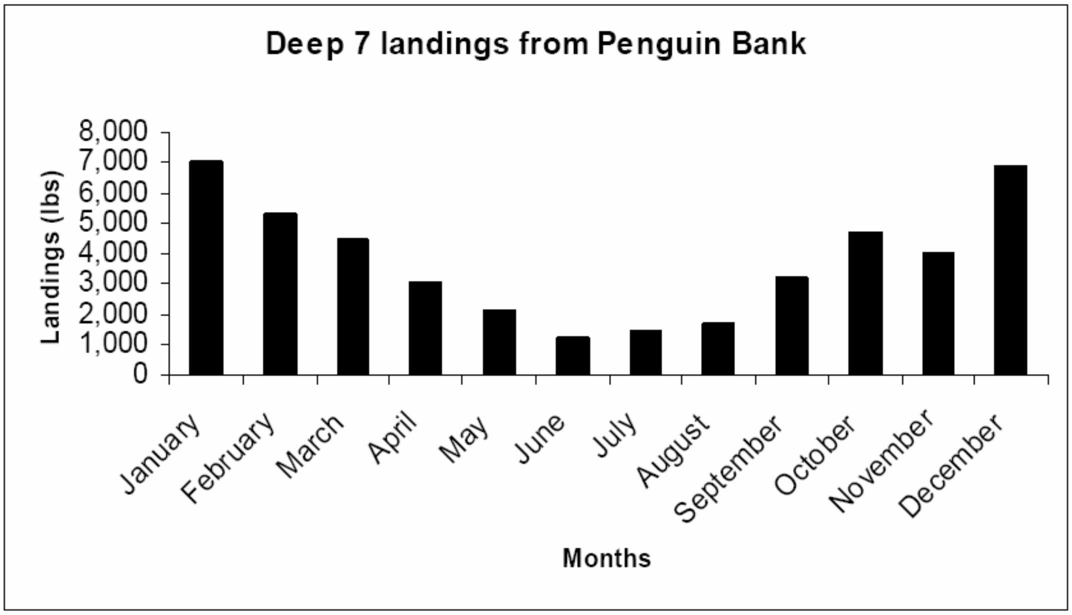


Figure 16: Average Monthly Percentage of Bottomfish Landings Formed by Fish Caught in Waters Under Federal Jurisdiction in the MHI. Source: Kawamoto et al. 2005.



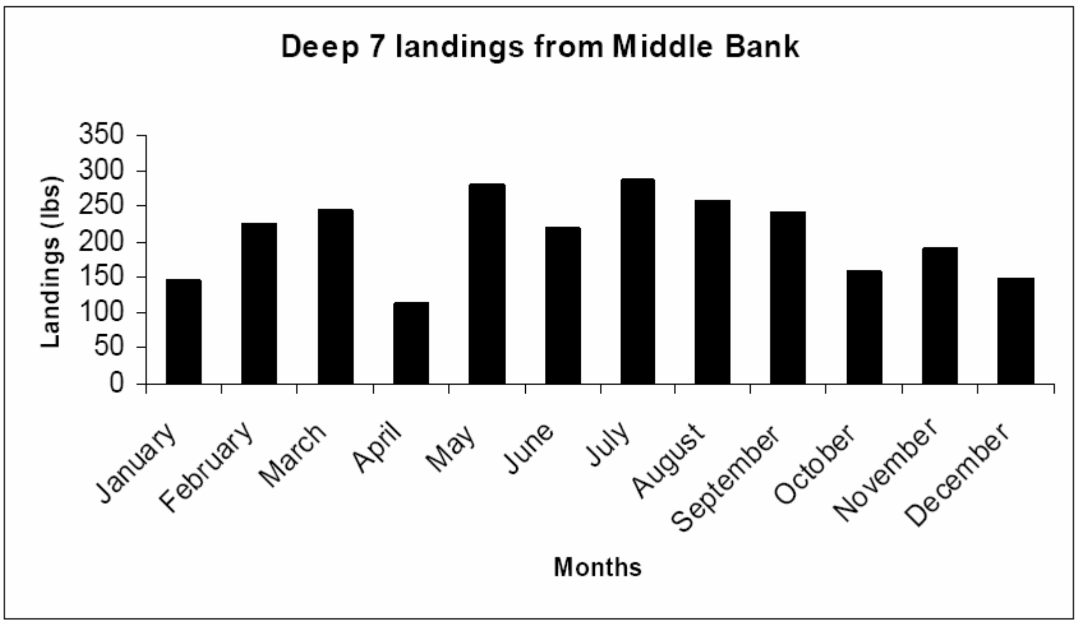


Figure 17: Landings of the Deep 7 Bottomfish Complex from the Two Principal Bottomfish fishing Under Federal Jurisdiction in the MHI. Source: Kawamoto et al. 2005.

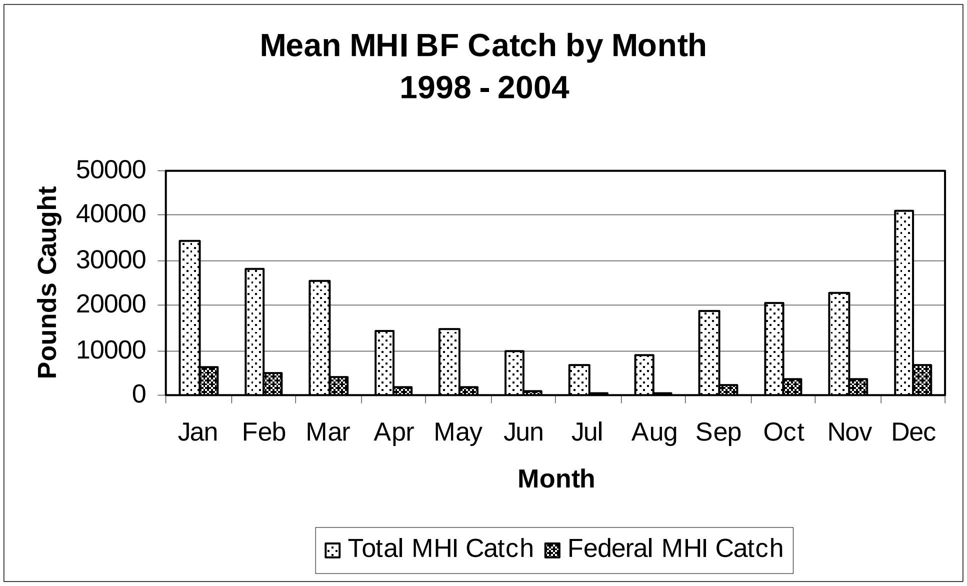


Figure 18: Mean MHI Bottomfish Catches by Month, 1998–2004. Source: Kawamoto and Gonzales 2005.

The annual cycle of landings from Penguin and Middle Banks shown in Figure 17 is also apparent in the annual cycle of landings in the entire MHI (Figure 18). The percentage of landings from federal waters in the MHI by month is shown in Figure 19.

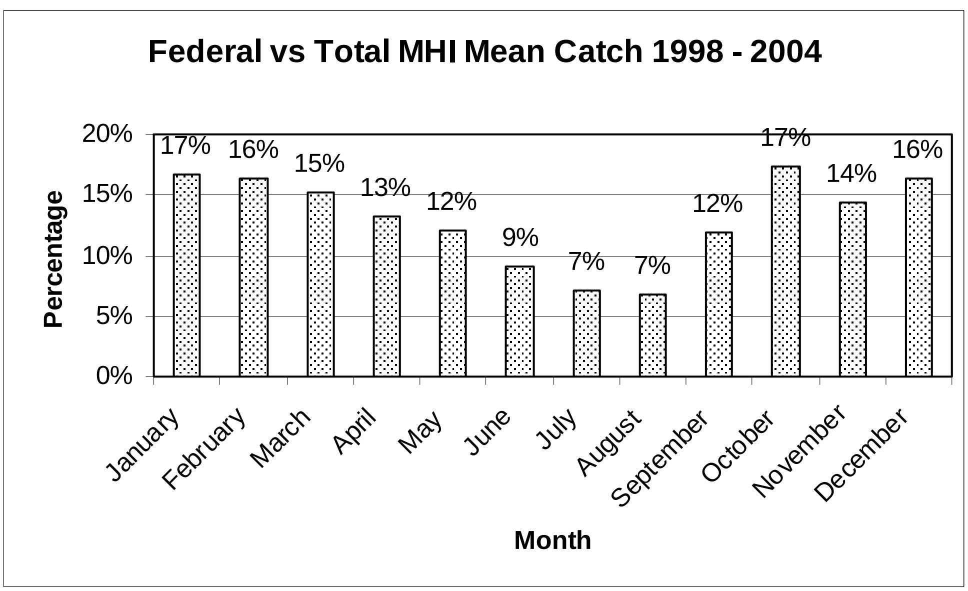


Figure 19: Federal Area Landings as a Percentage of the Total MHI Landings, 1998–2004. Source: Kawamoto et al. 2005.

3.4.4.3 CPUE

Table 31 presents a time-series of trip CPUE values in the Hawaii bottomfish fishing zones. In the MHI, highest CPUE was recorded in the mid-1950s. There seems to have been a discontinuity between 1981 and 1982 with more recent numbers being markedly lower. Absolute lowest CPUE was recorded in 1996 and 1998. The 2003 CPUE increased from that of 2002, but was still only 45 percent of the long-term mean value.

In the Mau Zone, CPUE on a per trip basis peaked in the late 1960s, with the lowest recorded value from 1993. CPUE has been relatively constant in recent years, but a 6-year high was recorded in 2003. The 2003 CPUE was 130 percent that of the mean of the previous 5 years.

In the Hoomalu Zone, trip CPUE has been relatively constant for many years. The 2003 value was the lowest seen in 19 years, but was still 90 percent of the mean of the previous 5 years. Figure 20 plots the trend in bottomfish CPUE in pounds per trip for the MHI fishery. The declining trend from 1948 to 1991 is apparent. Since 1992, the trend has been relatively stable.

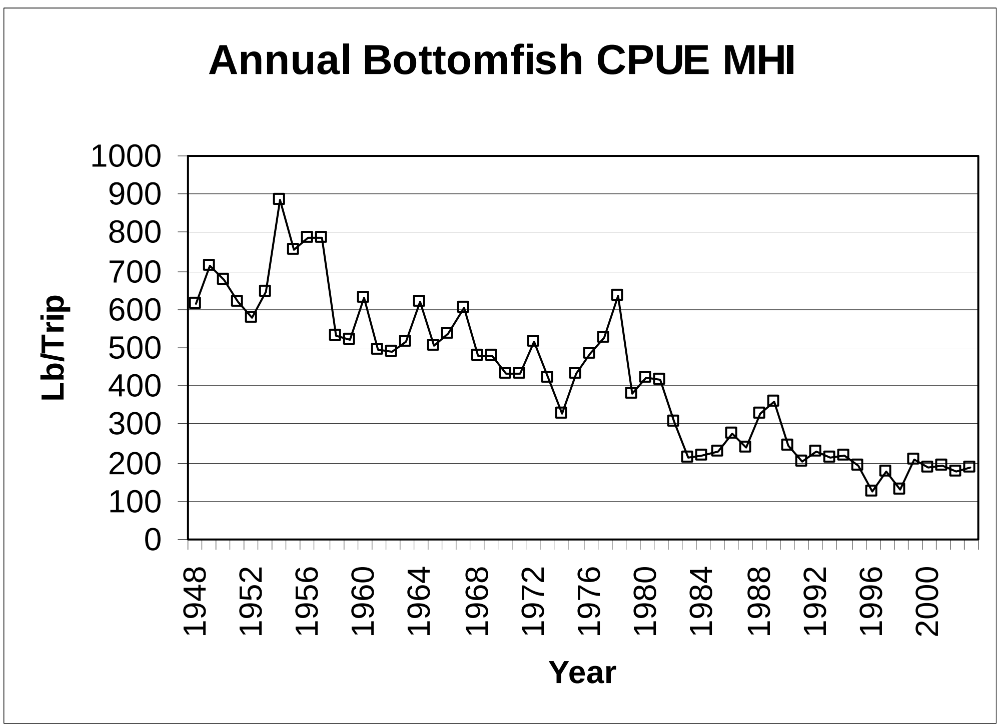


Figure 20: Bottomfish CPUE Trends in the MHI. Source: WPRFMC 2005c, 2003 Bottomfish Annual Report.

Table 31: Bottomfish CPUE in the MHI and NWHI, 1948–2003 (lb/trip).

Year	MHI	Mau	Hoomalu	Year	MHI	Mau	Hoomalu
1948	614	5,968	14,635	1977	527	4,387	4,000
1949	713	6,788	4,614	1978	635	4,753	3,550
1950	677	4,966	6,072	1979	380	5,361	4,951
1951	621	4.980	8,228	1980	421	6,210	6,687
1952	577	7,407	4,766	1981	416	1,336	8,167
1953	645	8,937	7,627	1982	307	NA	7,953
1954	887	6,158	8,613	1983	214	2,242	3025
1955	755	4,659	9,336	1984	220	4,308	4,085
1956	784	2,523	5,202	1985	230	4,239	5,909
1957	789	3,958	1,535	1986	274	2,206	5,301
1958	533	NA	6,254	1987	237	2,889	8,187
1959	519	NA	5,897	1988	329	2,136	4,702
1960	630	6,379	8,139	1989	361	5,412	5,328
1961	496	6,999	7,978	1990	245	4,454	4,793
1962	491	4,641	NA	1991	202	2,413	5,928
1963	518	6,410	NA	1992	228	2,092	7,388
1964	619	8,028	8,390	1993	213	1,992	8,040
1965	503	6,656	NA	1994	218	3,748	4,651
1966	536	4,413	NA	1995	193	2,460	5,544
1967	602	14,749	NA	1996	125	2,823	5,870
1968	478	6,055	NA	1997	176	3,294	5,234
1969	480	11,484	NA	1998	130	2,518	5,198
1970	433	7,111	NA	1999	209	2,926	4,605
1971	433	4,784	NA	2000	187	2,654	5,212
1972	514	2,386	NA	2001	194	2,066	5,300
1973	421	3,224	NA	2002	179	2,496	4,651
1974	329	3,367	NA	2003	190	3,293	4,481
1975	430	5,439	NA	*M*	424	4,676	6,096
1976	485	4653	NA	*SD*	196	2,493	2,187

Source: WPRFMC 2005c, 2003 Bottomfish Annual Report.

Table 32: Bottomfish CPUE in the MHI and NWHI, 1984–2003 (lb/day).

Year	Mau	Hoomalu	Combined	Year	Mau	Hoomalu	Combined
1984	NA	NA	682	1995	306	582	442
1985	NA	NA	736	1996	298	563	407
1986	NA	NA	800	1997	429	574	521
1987	NA	NA	877	1998	364	527	484
1988	322	866	786	1999	337	534	486
1989	677	808	763	2000	260	601	513
1990	573	675	611	2001	283	543	467
1991	333	671	525	2002	438	412	425
1992	239	639	491	2003	508	490	496
1993	267	723	523	*M*	374	615	581
1994	353	629	526	*SD*	122	116	139

Source: WPRFMC 2005c, 2003 Bottomfish Annual Report.

Calculations of partial CPUEs (CPUE by species) in the MHI for the major bottomfish species (2003 Annual Report) showed that values for all species except ōpakapaka were less than half of their early values. The decline is most apparent for ehu. If species targeting is taken into consideration, all four species for which there are sufficient data (ōpakapaka, onaga, ehu, and uku) show MHI CPUE less than or equal to 50 percent of their original values.

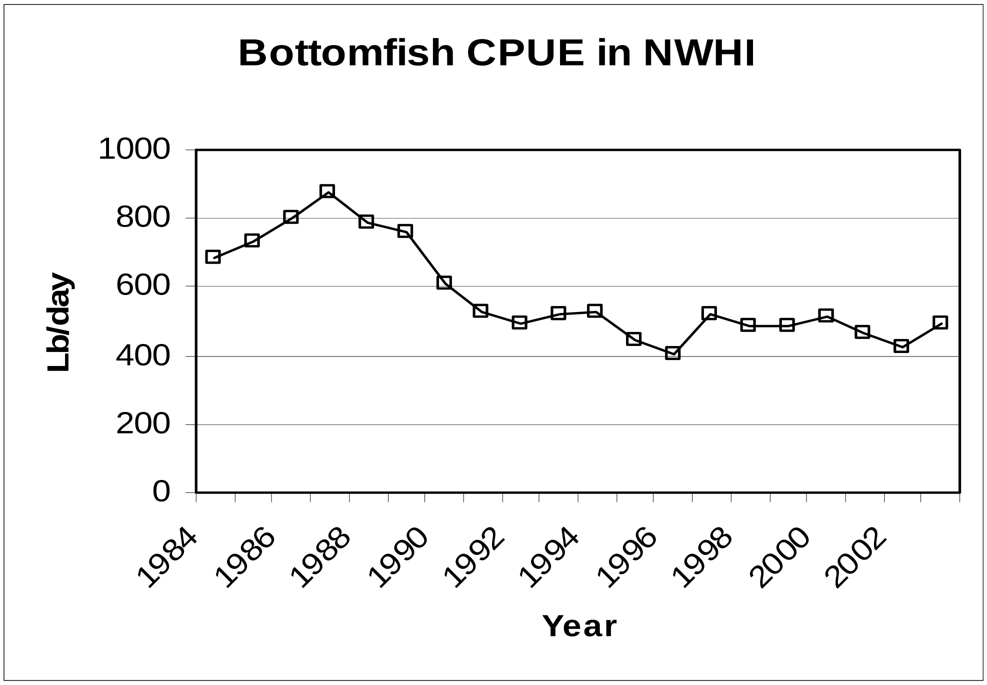


Figure 21: Bottomfish CPUE Trends in the NWHI. Source: WPRFMC 2005c, 2003 Bottomfish Annual Report.

For the NWHI, a better measure of CPUE is pounds per day, due to the greater variability in the length of trips. On a catch-per-day basis (Table 32), the 2002 and 2003 CPUE in the Mau Zone were the highest since the 1989 to 1990 period. The 2003 CPUE was 151 percent of the mean of the previous 5 years. In the Hoomalu Zone, the highest daily CPUEs were also recorded in the late 1980s, but unlike the trend in the Mau Zone, CPUEs in the past two years in the Hoomalu Zone were the lowest recorded from that area. The 2003 Hoomalu daily CPUE was 94 percent of the mean for the previous 5 years. The combined CPUE trend can be seen in Figure 21.

3.4.4.4 Revenues and Prices

Inflation-adjusted gross revenue in the MHI bottomfish fishery grew steadily in the 1980s (Table 33) as a result of increases in both real prices and landings (WPRFMC 2003). However, beginning in 1990, revenue in the MHI fishery decreased sharply as both MHI bottomfish prices and landings declined. Inflation-adjusted revenue in the MHI fishery reached its lowest levels ever in 2001. Revenues from 2001 to 2003 were all below the previous low value, although the trend was upward slightly during those years. Similarly, inflation-adjusted revenues in the NWHI fishery reached their lowest levels ever in the 2001 to 2003 period, with 2003 having the lowest recorded level.

Revenue from the MHI fishery was always greater than that from the NWHI. Before the mid-1980s, MHI bottomfish revenue made up over 80 percent of the total Hawaii bottomfish revenue. The proportion declined due to a dramatic increase of NWHI bottomfish landings in the mid-1980s, and the MHI revenue was about 50 percent of the total during the period 1985–1987. Since then, revenues in both areas have declined, but revenue from the MHI fishery remains above that of the NWHI. It was 67 percent of the total in 2003.

Historically, bottomfish catches from the MHI have tended to command higher aggregate prices than those caught in the NWHI, reflecting a larger proportion of preferred species and greater freshness. In the late 1990s, however, the prices appeared to converge, perhaps due to the softness of the upscale part of the Hawaii market as the state’s economic recession continued (WPRFMC 1999). From 2001 through 2003, however, the price differential between MHI and NWHI fish widened considerably, possibly a result of the large increase in imported bottomfish substituting in the market for NWHI fish. The 2003 inflation-adjusted per pound price for NWHI fish was the lowest ever recorded. This was in marked contrast to the inflation-adjusted prices received for MHI bottomfish, which reached their highest level in 13 years.

Table 33: Inflation-Adjusted BMUS Revenue and Price, MHI and NWHI, 1984–2003.

Year	MHI Revenue ($1,000)	NWHI Revenue ($1,000)	MHI Price	NWHI Price
1984	3,179	2,388	4.21	3.61
1985	3,341	3,078	4.65	3.33
1986	3,432	3,178	4.53	3.66
1987	3,733	3,661	5.00	3.61
1988	4,940	2,254	4.46	3.61
1989	4,396	1,075	4.68	3.56
1990	2,978	1,416	4.99	3.35
1991	2,123	1,305	4.15	3.37
1992	2,180	1,485	4.02	3.50
1993	1,762	1,336	4.13	3.47
1994	2,009	1,548	4.09	3.50
1995	1,992	1,161	3.81	3.14
1996	1,719	1,067	4.23	3.45
1997	1,703	1,185	3.63	3.43
1998	1,631	993	3.73	3.19
1999	1,482	1,173	3.65	3.64
2000	1,717	944	3.84	3.85
2001	1,309	750	3.79	3.21
2002	1,396	777	4.13	3.39
2003	1,460	716	4.35	3.13

Source: WPRFMC 2005c, 2003 Bottomfish Annual Report.

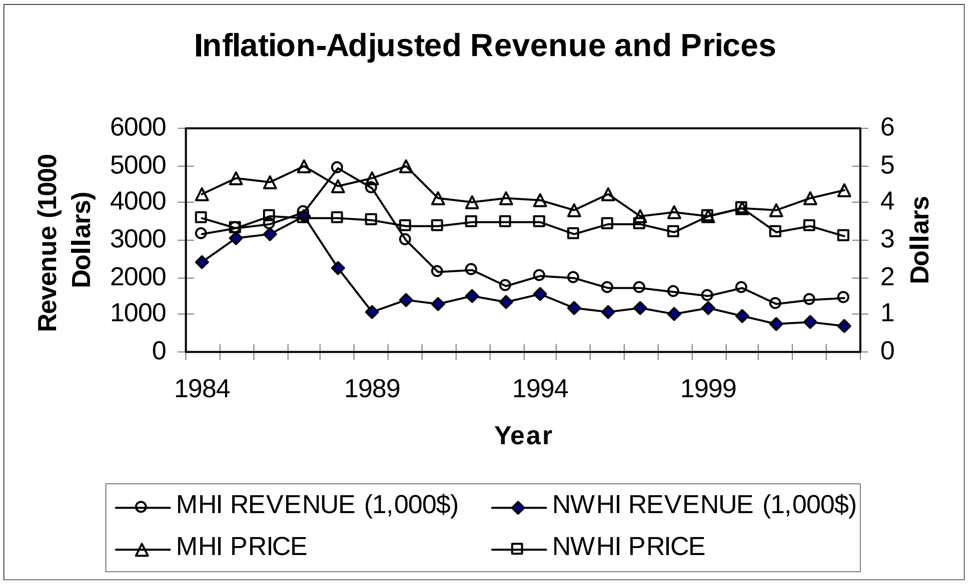


Figure 22: Annual Revenues and Average Prices by Bottomfish Management Zone. Source: WPRFMC 2005c, 2003 Bottomfish Annual Report.

Table 34: MHI Bottomfish Prices by Month and Year for the Deep 7 Species (2000–2004).

		Onaga			
	2000	**2001**	**2002**	**2003**	**2004**
January	6.61	5.94	6.21	6.19	6.54
February	5.12	6.34	6.19	6.46	6.37
March	6.07	5.73	6.46	5.85	6.77
April	7.55	6.95	5.59	6.20	6.90
May	7.05	7.13	6.81	6.24	6.91
June	6.78	6.61	7.74	6.25	7.39
July	**8.09**	7.48	**8.09**	**7.77**	7.22
August	7.48	**8.42**	7.43	6.73	**8.06**
September	5.64	6.78	5.70	5.23	6.70
October	6.03	5.57	5.50	5.34	5.99
November	7.05	4.98	5.62	6.25	5.70
December	6.05	7.54	6.16	7.72	6.93

		Ōpakapaka			
	2000	**2001**	**2002**	**2003**	**2004**
January	5.09	4.33	5.24	5.67	5.57
February	4.14	4.68	5.38	5.20	5.24
March	4.62	4.55	5.72	4.76	5.63
April	**6.07**	5.02	4.76	5.47	5.54
May	5.02	5.18	5.57	5.38	5.27
June	4.86	4.75	**6.03**	5.00	5.56
July	5.30	5.11	6.08	5.52	5.39
August	5.20	5.62	5.81	5.24	5.41
September	4.40	4.94	4.93	5.05	5.36
October	4.59	4.75	4.70	4.78	4.81
November	5.31	4.34	4.48	5.12	4.69
December	4.29	**5.76**	4.84	**6.12**	**5.73**

		Ehu			
	2000	**2001**	**2002**	**2003**	**2004**
January	4.65	3.82	4.52	4.81	4.57
February	3.60	4.52	5.20	4.16	4.92
March	4.42	4.09	4.99	4.39	5.34
April	5.27	5.05	4.27	5.12	5.24
May	4.58	4.85	4.72	4.24	4.53
June	4.36	4.62	5.74	4.10	4.78
July	**5.80**	5.09	**6.84**	5.13	3.16
August	5.21	5.26	5.54	5.37	5.27
September	4.22	5.06	4.50	4.13	**5.61**
October	4.64	4.92	4.55	4.40	4.78
November	4.80	4.11	4.50	5.24	4.34
December	4.43	**5.61**	4.32	**6.08**	5.35

		Lehi			
	2000	**2001**	**2002**	**2003**	**2004**
January	3.21	2.98	3.48	3.61	4.06
February	3.03	3.19	3.43	**3.65**	3.38
March	3.48	2.63	3.46	3.54	3.24
April	3.43	2.78	3.02	2.97	3.05
May	3.01	2.32	3.08	2.70	2.39
June	2.68	2.47	1.87	2.65	3.83
July	2.81	3.43	**4.59**	2.62	2.95
August	3.16	**3.62**	2.38	2.87	3.48
September	3.15	2.71	2.95	3.06	3.19
October	3.09	2.84	2.87	2.76	**4.10**

November	**3.49**	2.50	2.67	3.16	3.51
December	3.03	3.19	3.02	3.27	3.54

Kalekale

	2000	**2001**	**2002**	**2003**	**2004**
January	**3.75**	2.69	3.15	2.91	3.39
February	2.58	3.23	3.77	3.21	3.37
March	2.92	3.23	**4.32**	3.02	**4.35**
April	3.49	3.27	3.22	3.33	3.73
May	3.31	3.07	3.14	2.81	3.70
June	3.25	2.94	3.29	3.10	3.93
July	3.64	2.97	3.98	1.42	3.10
August	3.49	**3.69**	4.11	2.89	3.87
September	2.87	3.12	3.34	3.19	4.14
October	3.28	3.44	3.31	3.16	3.42
November	3.54	2.64	2.88	3.18	2.93
December	2.74	3.39	2.64	**3.93**	3.21

Gindai

	2000	**2001**	**2002**	**2003**	**2004**
January	**4.36**	3.03	3.41	3.17	3.30
February	3.48	3.98	4.02	3.39	3.86
March	3.46	3.59	4.19	3.16	3.87
April	3.77	**4.02**	3.62	2.87	3.58
May	3.93	3.30	3.43	2.91	3.84
June	3.67	2.79	4.17	2.50	3.95
July	4.11	3.58	**4.65**	3.92	3.34
August	4.08	3.68	3.66	3.82	3.61
September	3.65	3.60	3.16	3.62	**4.25**
October	3.52	3.52	3.40	3.74	3.58
November	3.75	2.89	3.03	3.66	3.74
December	3.29	3.32	3.08	**4.28**	3.55

	Hapuupuu				
	2000	**2001**	**2002**	**2003**	**2004**
January	3.37	3.07	4.65	4.40	4.99
February	3.57	3.79	4.40	4.12	**5.43**
March	3.78	3.55	4.64	4.16	4.67
April	4.69	4.25	4.24	4.05	5.06
May	3.60	3.73	3.89	4.67	4.50
June	3.46	4.42	**6.47**	3.73	4.27
July	4.25	4.35	3.55	4.51	4.62
August	**4.74**	**4.79**	3.68	5.07	4.71
September	3.81	3.97	4.24	4.40	5.31
October	3.36	4.22	3.92	3.97	3.86
November	3.05	3.90	4.25	4.91	4.58
December	3.22	4.77	4.06	**5.09**	5.04

Source: Kawamoto and Gonzales 2005c.

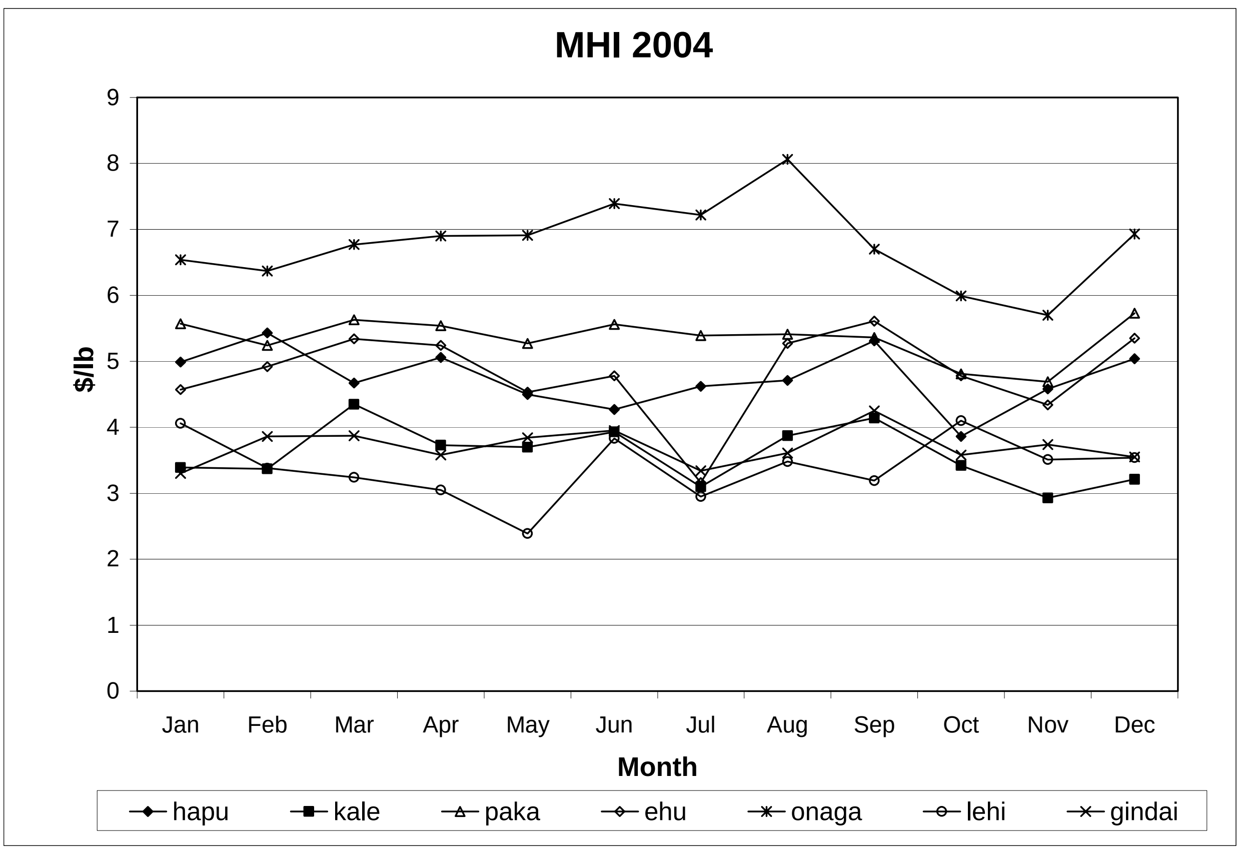


Figure 23: Average Prices by Species by Month for the MHI. Source: Kawamoto and Gonzales 2005c.

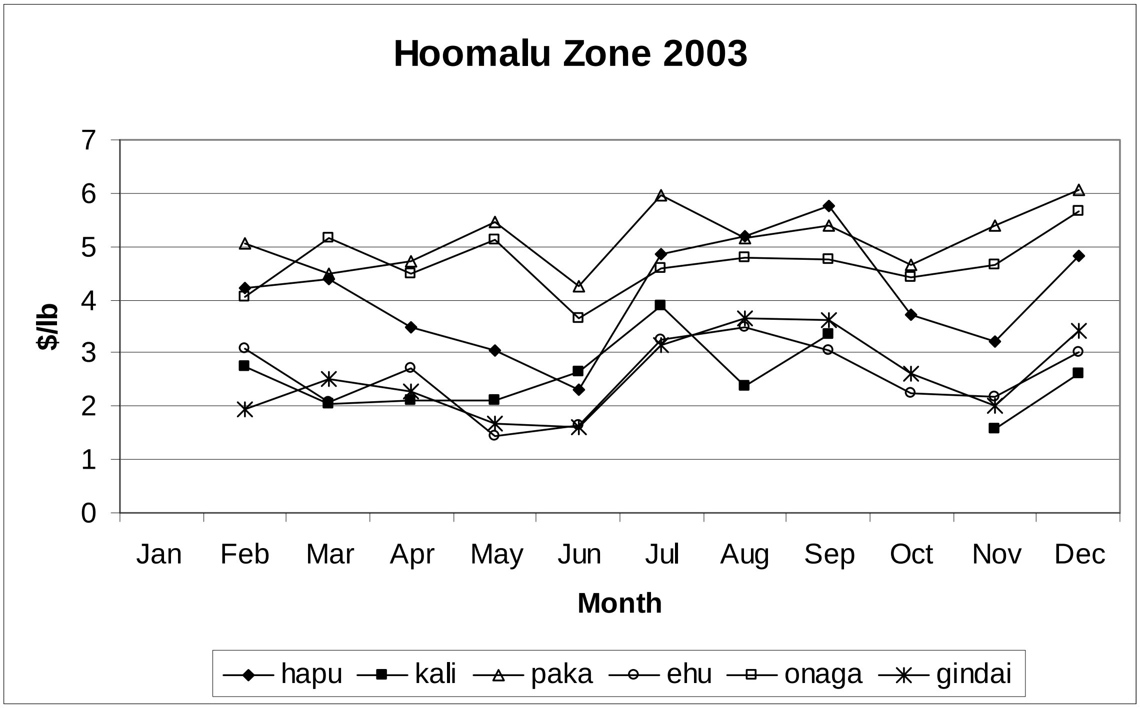


Figure 24: Average Prices by Species by Month for the Hoomalu Zone. Source: WPRFMC 2005c, 2003 Bottomfish Annual Report.

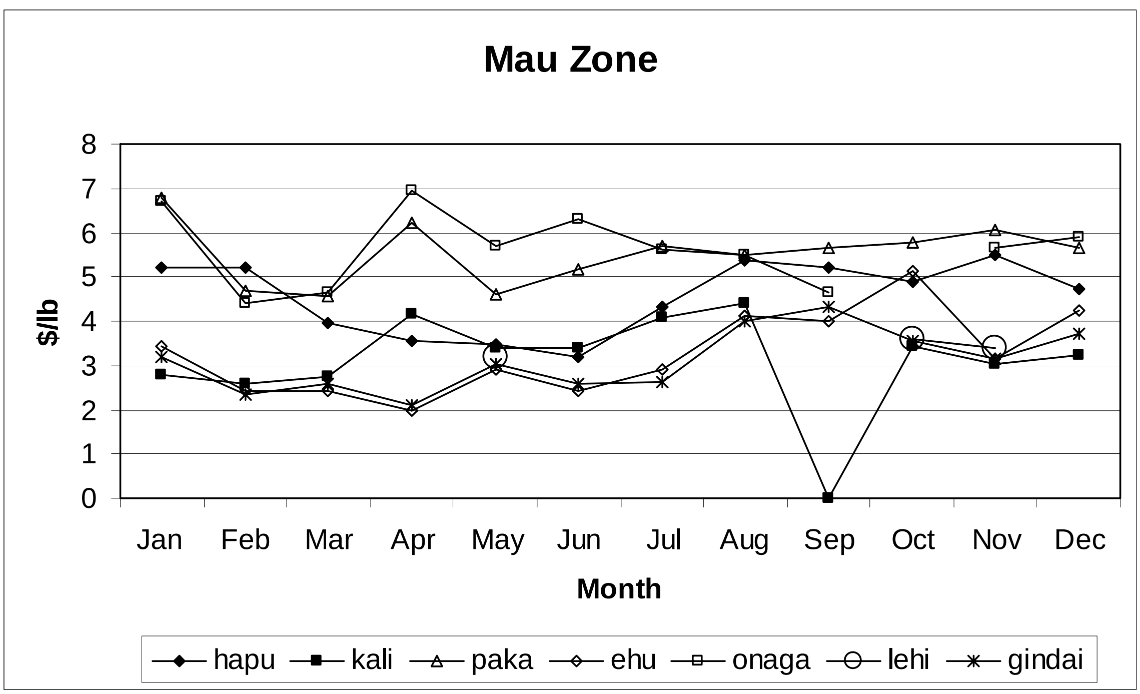


Figure 25: Average Prices by Species by Month for the Mau Zone. Source: WPRFMC 2005c, 2003 Bottomfish Annual Report.

3.4.5 Processing and Marketing

A market for locally caught bottomfish was well-established in Hawaii by the late nineteenth century. Today, fresh bottomfish continues to be important seafood for Hawaii residents and visitors. Nearly all bottomfish caught in the NWHI fishery are sold through the Honolulu fish auction (United Fishing Agency, Ltd.). Prices received at the auction change daily, and the value of a particular catch may even depend on the order in which it is placed on the floor for bidding (Hau 1984). Bottomfish caught in the MHI fishery are sold in a wide variety of market outlets (Haight et al. 1993a). Some are marketed through the fish auction in Honolulu and intermediary buyers on all islands. Sales of MHI bottomfish also occur through less formal market channels. For example, local restaurants, hotels, grocery stores, and individual consumers are important buyers for some fishermen. In addition to being sold, MHI bottomfish are consumed by fishermen and their families, given to friends and relatives as gifts, and bartered in exchange for various goods and services.

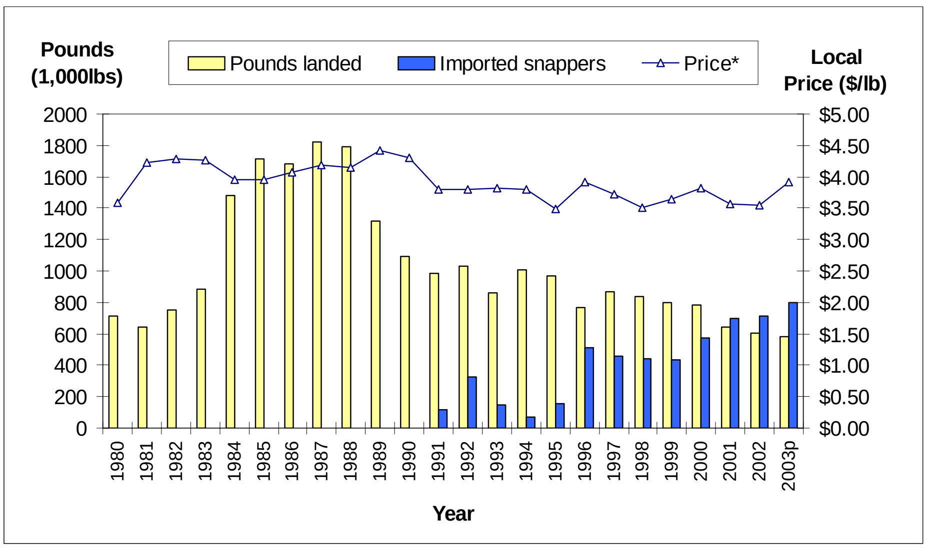


Figure 26: Hawaii Bottomfish Demand (Annual, Inflation-Adjusted Ex-Vessel Price and Supplies [Domestic Landings and Imported Fresh Snapper]), 1980–2003. Source: WPRFMC 2005c, 2003 Bottomfish Annual Report.

Historically, the demand for bottomfish in Hawaii has been largely limited to fresh fish. Seventy years ago Hamamoto (1928) remarked on the fact that fish dealers in Honolulu refused to buy fish that had been harvested in the NWHI and frozen on board because the demand for this product was so low. In the last few years the price differential between frozen and fresh product has narrowed for some species of bottomfish, but it remains substantial for onaga and ehu, the two highest priced fish. Until the market for frozen bottomfish develops, participants in the NWHI fishery will be caught in the same ongoing dilemma, they must stay out long enough to cover trip expenses, but keep the trips short enough to deliver a readily saleable, high-quality product (Pan 1994). In the past, bottomfish catches from the MHI have tended to command higher aggregate prices than those caught in the NWHI, reflecting the greater freshness required by the "sashimi" grade market. Bottomfish caught around the MHI are iced for only 1 to 2 days before being landed, whereas NWHI fresh catches may be packed in ice for 10 days or more. By the late 1990s, however, the prices appeared to converge, perhaps due to the softness of the upscale part of the Hawaii market as the state's economic recession continued (Western Pacific Regional Fishery Management Council 1999).

Catches of bottomfish around the MHI typically consist of plate-sized fish preferred by household consumers in Hawaii and by restaurants where fish are often served with the head on. Medium to large bottomfish from the MHI are often targeted for export markets and local high-end specialty restaurants that demand the highest sashimi grade quality. Bottomfish caught around the NWHI tend to be the medium to large fish (over 5 pounds) preferred for the restaurant fillet market. Because the percent yield of edible material is high, handling costs per unit weight are lower, and more uniform portions can be cut from the larger fish.

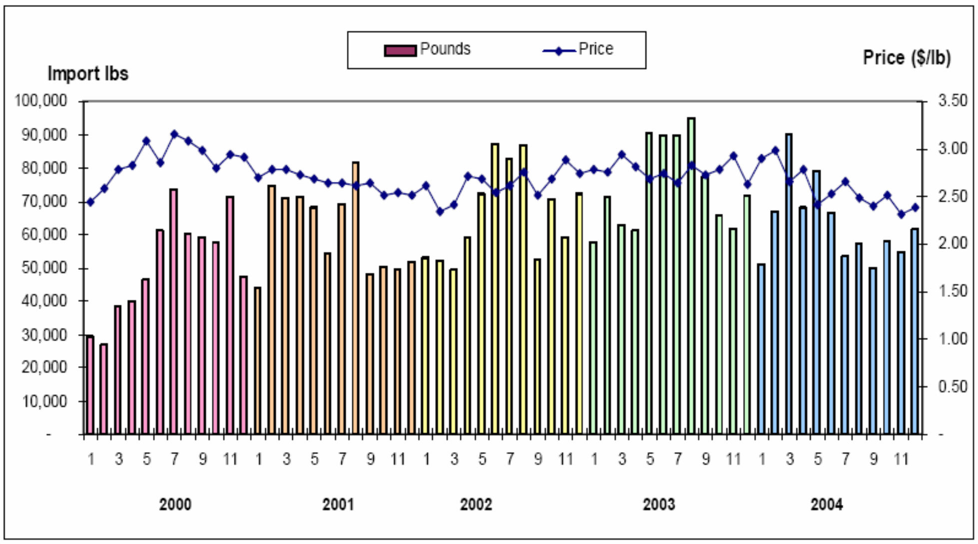


Figure 27: Monthly Imports of Bottomfish into Hawaii, 2000-2004. Source: PIFSC 2005, unpublished data.

Pooley (1987) showed that Hawaii auction market prices increase when MHI landings drop. However, during the 1990s the relationship between price and volume faltered, perhaps due to an increase in imported fresh fish that competed in the market with locally caught bottomfish (WPRFMC 1999; Figure 27). According to U.S. Customs data for the Port of Honolulu, 715,000 pounds of snapper were imported in CY 2002, worth $1.92 million ($2.68 per pound; WPRFMC 2004). This amount exceeded domestic supplies and thus was a significant factor in ex-vessel prices. Not only has the quantity of foreign-caught fresh fish increased during the last few years, but the number of countries exporting fresh fish to Hawaii has also increased. Fifteen years ago, for example, fresh snapper was exported to Hawaii mainly from within the South Pacific region. In recent years, Tonga and Australia were the largest sources of fresh snapper, with Fiji and New

Zealand also being major sources, but fresh snapper have also been received from Indonesia, Samoa, Vietnam, Chad, and Madagascar.[10]

To further explore the value of Hawaii's fresh local bottomfish, and the role imports play in the market, the Council sponsored a study of the attitudes and beliefs of Hawaii restaurateurs and executive chefs (Coffman 2004). The objectives of the study were to (a) determine the value added to NWHI bottomfish in Hawaii's restaurants and (b) determine whether NWHI bottomfish are easily substituted for both in chefs' and customers' preferences, with bottomfish from other places or other types of fish. Table 35 summarizes the quantitative information derived from interviews with 24 of Hawaii's top chefs and six seafood wholesalers.

Table 35: Hawaii Chefs and Wholesalers Perceptions of Hawaii Bottomfish.

Interview Result	**Percentage of chefs interviewed**
Knew if their fish was from the MHI of the NWHI	0
Only serve Hawaii-caught bottomfish	19
Try to serve Hawaii-caught bottomfish	29
Advertise bottomfish dishes as "Fresh Island Fish" of similar	29
Volunteered that the price of bottomfish is high and/or rising	29
Volunteered concern over bottomfish sustainability	73
Volunteered concern about fishing regulations driving up bottomfish prices	14
Said customers are willing to pay more for Hawaii-caught bottomfish	42.8
Said customers are not willing to pay more for Hawaii-caught bottomfish	19
Said customers expect Hawaii-caught bottomfish to be less expensive in Hawaii relative to other fish dishes	9.5
Named bottomfish on list of "most desirable fish species"	77.3
	Other Chef Responses
Average percentage of meals that are fish	48.6
Average percentage of fish meals that are bottomfish	26.5
Average price of Hawaii-caught bottomfish dish	$29.52
Average price of an imported bottomfish dish	$28.46
Average portion size of a bottomfish dish	6.78 oz
Average product yield of whole fish (usefulness increases if stock made)	50%
Average days last month with bottomfish on menu	26.8
Average days last year with bottomfish on menu	325.4
Average percentage customers who are visitors to Hawaii	40.7%

[10]http://www.st.nmfs.gov/pls/webpls/trade_dist_allproducts_mth.results?qtype=IMP&qmonthfrom=01&qmonthto=01&qyearfrom=1996&qyearto=2005&qproduct=%25&qdistrict=32&qsort=COUNTRY&qoutput=TABLE

	Percentage of Wholesalers Interviewed
Said MHI are better in quality than NWHI bottomfish	100
Said NWHI and imported bottomfish are comparable in quality	33
Said imported better than NWHI bottomfish	33
Said quality difference between imported and NWHI bottomfish depends on the country of origin	66
Said price of bottomfish is high, but steady	33

Source: WPRFMC 2004.

The survey found that it was typical for the restaurant to purchase Hawaii-caught bottomfish fillets from a wholesaler at a price of $12 to $16 per pound. NWHI bottomfish were more suitable for filleting than MHI fish because of their larger size, but the higher quality of MHI fish allowed their use for sashimi. Summary conclusions of the study were as follows:

> Bottomfish is a popular dish in most of Oahu's top-end restaurants. Several of the most noted "boutique type" restaurants only serve Hawaii-caught bottomfish. The expensive prices as well as the inconsistency of supply of both MHI and NWHI bottomfish make it difficult for most restaurants to serve only Hawaii-caught fish. Most restaurants serve a combination of Hawaii-caught and imported bottomfish. Because of obvious time factors, MHI bottomfish are considered the freshest and highest quality by most wholesalers while NWHI bottomfish can be comparable to some imports. It seems that some countries' fishermen are able to come into port soon enough, handle the fish well enough, and can fly to bottomfish over to Hawaii in a manner timely enough to rival the average quality of a bottomfish boat that comes into port for the NWHI every few weeks. The NWHI bottomfish fishery does, however, help fill the niche of Oahu restaurants who only serve Hawaii-caught fish.

3.4.6 Bycatch

Most fisheries have both nontarget species (not the target of fishing, but kept for consumption or sale) and bycatch (discards). If the fish, or any part of it, is used or sold, it is incidental catch of non-target species, not bycatch. Thus, for example, in years past, when there was no prohibition on fining sharks, the discarded shark carcass was not bycatch. It is also important to note that the MSA includes turtles as bycatch, but not marine mammals or seabirds. The discussion below focuses on bycatch of fish species. Turtles are discussed later, in the protected species section.

3.4.6.1 Magnuson–Stevens Act (MSA) Definitions and Requirements

Bycatch is defined as follows in the MSA (§3[2, 12, 9, and 33]):

> The term "bycatch" means fish which are harvested in a fishery, but which are not sold or kept for personal use, and includes economic discards and regulatory

> discards. Such term does not include fish released alive under a recreational catch and release fishery management program.
>
> The term "fish" means finfish, mollusks, crustaceans, and all other forms of marine animal and plant life other than marine mammals and birds.
>
> The term "economic discards" means fish which are the target of a fishery, but which are not retained because they are of an undesirable size, sex, or quality, or for other economic reasons.
>
> The term "regulatory discards" means fish harvested in a fishery which fishermen are required by regulation to discard whenever caught, or are required by regulation to retain but not sell.

The National Standard Guidelines (50 CFR 600.350(c)) extend the definition of bycatch to include the following:

> Fishing mortality due to an encounter with fishing gear that does not result in capture of fish (i.e. unobserved fishing mortality).

The 1996 SFA amendments to the MSA added two key requirements of FMPs regarding bycatch. First, the new National Standard 9 (MSA §301(a)(9)) requires that

> conservation and management measures shall, to the extent practicable, (a) minimize bycatch and (b) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.

Second, MSA §303(a)(11) requires that FMPs

> establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery, and include conservation and management measures that, to the extent practicable and in the following priority:
>
> (a) minimize bycatch; and
> (b) minimize the mortality of bycatch which cannot be avoided.

3.4.6.2 Available Estimates of Bycatch and Bycatch Mortality

In Hawaii, there are two separately managed bottomfish fisheries: a strictly commercial fishery in the NWHI, and a mixed commercial, recreational and subsistence fishery in the MHI. While these fisheries use the same gear and operational methods, the motivation of the fishermen is different between the commercial operators and recreational or subsistence fishermen. This results in different bycatch characteristics. The NWHI commercial fishermen seek the highest economic return on their catch and therefore may release alive lower valued species, especially early in a trip, thereby conserving both ice and hold space.

Bottomfish fishermen in the NWHI and the MHI have been voluntarily involved with the State of Hawaii's ulua and multi-species tagging programs. Fishermen have routinely reported that even without such a program that they release many unwanted fishes alive (Kawamoto, PIFSC, personal communication). Data on bycatch in the NWHI commercial fishery is available from the logbook program, from limited observer data, and from NMFS research cruises in the NWHI.

Because the State of Hawaii and NMFS do not have permit, logbook, or catch reporting system for noncommercial marine fishermen, there are no data on bycatch for this sector. Recreational or subsistence fishermen may be more inclined to retain a greater variety of species for home consumption or distribution to relatives and friends, thus their bycatch percentages are likely substantially less that that of the commercial sector (Kawamoto, PIFSC, personal communication).

Bottomfish gear types and fishing strategies are highly selective for desired species and sizes. Management measures that serve to further reduce bycatch in the bottomfish fishery include prohibitions on the use of bottom trawls, bottom gillnets, explosives, and poisons.

3.4.6.3 Bycatch in the Main Hawaiian Islands Bottomfish Fishery

A summary of the bycatch in the main Hawaiian Islands bottomfish fishery is given in Figures 29 and 30. This information is from catch and effort data submitted to HDAR by MHI commercial bottomfish fishery participants during 2003 and 2004. Bycatch as defined by the MSA and the National Standard Guidelines includes not only discards but unobserved mortality, which is defined as "mortality due to an encounter with fishing gear that does not result in capture of the fish." The State of Hawaii catch and effort report collects information on "lost" fish, i.e. fish that were lost after being hooked. In the deepwater bottomfish fishery the species identification and number of "lost" fishes are questionable as they were lost for various or unknown reasons during retrieval at depths that are not directly observable. Therefore the positive identification by species and an accounting of numbers are likely inaccurate but are necessarily used. The percentage of mortality of these "lost" fish is unknown and it is likely that not all die from the encounter. Therefore the fish "lost" numbers are considered conservative as under the MSA they are all counted as unobserved mortalities (including those that survive). Overall, bycatch in the MHI bottomfish fishery is low, with only 8.5 percent of the catch falling into the bycatch category (Figure 28).

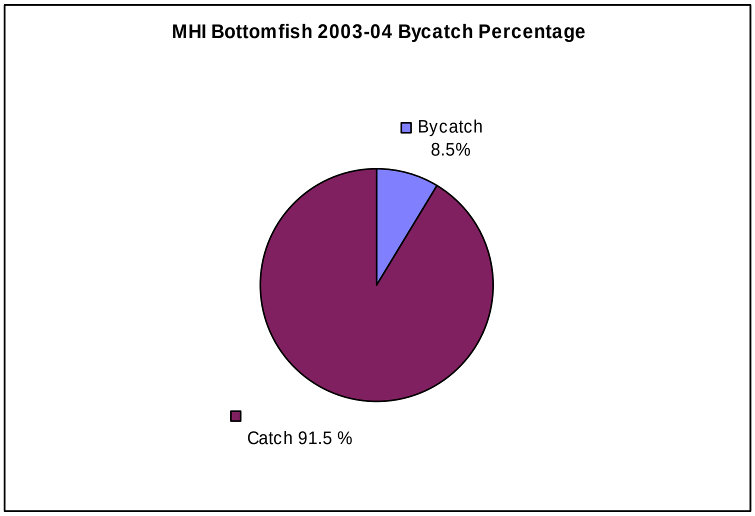


Figure 28: Ratio of Bycatch to Catch in the MHI. Source: Kawamoto and Gonzales 2006.

The average bycatch ratios and composition of the MHI bottomfish catch for 2003 and 2004 combined are presented in Figure 28. The total bycatch in the fishery for the combined years is 8.5 percent. Each individual set of species (PMUS, BMUS, and miscellaneous) contributes to this overall percentage.

PMUS catches comprise under one percent (0.9 percent) of the total catch with less than one percent (0.3 percent of total catch) being considered bycatch. The majority of the pelagic bycatch are composed of sharks (88 percent of PMUS bycatch).

The targeted BMUS species in the MHI bottomfish fishery are six snappers and one grouper, collectively known in Hawaii as the Deep 7 species complex. Very little of the targeted Deep 7 species catch (3.3 percent) is reported as bycatch. Looking at the entire BMUS complex (Deep 7 and other BMUS) the bycatch percentage rises to 7.5 percent. The majority of the BMUS bycatch is composed of kahala, butaguchi, and white ulua. All of these species are members of the jack family (Carangidae) and are not included in the Deep 7 species complex. Ninety three percent of all kahala (*Seriola dumerili* and *S. rivoliana*) were reported as bycatch. Release of kahala are high because they are known to be ciguatoxic and therefore have no market value in Hawaii.

The miscellaneous species category includes over 30 species of near-shore and pelagic fishes that are occasionally caught while bottomfish fishing. Miscellaneous species account for less than one percent (0.7 percent) of the overall bycatch while comprising 4.4 percent of the overall catch.

Table 36: Bycatch Percentage by Species Grouping for 2003-2004.

	# pieces caught	# release	# damage	# lost	tot # caught	percent bycatch	percent of catch
PMUS	317	122	0	4	443	0.3	0.9
BMUS							
"Deep 7"	39569	61	0	1541	41171	3.3	86.0
Other BMUS	2147	1950	0	47	4144	4.2	8.7
total BMUS (D-7+Other)	41716	2011	0	1588	45315	7.5	94.7
Misc. species	1760	26	0	304	2090	0.7	4.4
Totals	43793	2159	0	1896	47848	8.5	100.0

Source: Kawamoto and Gonzales 2006.

At recent public meetings conducted in support of this proposed management action, numerous comments were heard by fishermen from Hilo to Kauai regarding the significant increase in the last 3 years of fish loss to shark predation. Several fishermen reported that during certain times, no fish can be brought to the surface without it being taken by sharks.

3.4.6.4 Bycatch in the NWHI Bottomfish Fishery

The major discard species in the NWHI bottomfish fishery are given in Table 36. It should be noted that a large percentage of the snappers and the grouper listed are included as bycatch because of damage from sharks. Logbook data (State of Hawaii), and observer programs conducted by NMFS indicate that total discards (including damaged target species) account for approximately 8 to 23 percent of the total catch in bottomfish fisheries in the Hawaiian archipelago (Nitta 1999; WPRFMC 1998a). Carangids, sharks, and miscellaneous reef fish (pufferfish, moray eels, etc.) are the most numerous discard species. Two species in particular, kahala (*Seriola dumerili, S. rivoliana*) and butaguchi (*Pseudocaranx dentex*), make up the majority of the bycatch. It is believed that the discarding of these types of fish (e.g. sharks, jacks) does not result in mortality as these types of fish do not suffer from barotraumas effects when brought up from depth. Most species are not kept by vessels because of their unpalatability, however some carangids (large jacks and amberjacks) are also discarded because of concerns of ciguatera poisoning.[11] Butaguchi, which commands a low price in the Hawaii market, may be discarded in the early days of a fishing trip because this species has a poor product shelf-life. The major discard species in the NWHI bottomfish fishery as reported by NMFS observers are given in Table 37. It should be noted that a large percentage of the snappers and the grouper listed are included as bycatch because of damage from sharks.

[11] Ciguatera fish poisoning results from eating a fish containing a neurological toxin produced by a microscopic dinoflagellate algae. The algae grow epiphytically on benthic macroalgae (seaweeds) and are ingested by herbivorous fish that in turn are eaten by larger carnivorous fish, with each step concentrating the toxin. In humans, ciguatera poisoning may cause severe illness or even death.

In bottomfish fishing operations, the largest proportion of lost fish and gear is attributable to interactions with sharks (Nitta 1999). From time to time some fishing areas are dominated by sharks such that the majority of hooked fish are either stolen or damaged. It appears that the time periods of high incidences of predator damage to the catches are not constant over years or even areas. Predator abundance and fishery losses vary and the reasons for this occurrence are unknown. The estimated economic losses experienced by fishermen as a result of shark interference with fishing operations are substantial (Kobayashi and Kawamoto 1995). In the NWHI, the gray reef shark (*Carcharhinus amblyrhnchos*) is believed to be the species of shark that interferes most with the bottomfish catch.

Data collected by NMFS during research bottomfish fishing cruises indicate the potential species composition of bycatch in the NWHI bottomfish fishery (Figure 29). Research bottomfish fishing is less likely to exclusively successfully target commercial species; however Figure 29 indicates the specific families of species that may be caught in association with bottomfish fishing operations.

The most recent data available (WPRFMC 2004) reinforce the trends described above, including the differences in strategy between Mau and Hoomalu Zone operations. In both zones in 2002, 100 percent of the sharks and kahala were discarded. In the Mau Zone, butaguchi was frequently discarded in 2002 (22 percent), unlike in 2001 when only 1 percent was discarded. The only other significant discard was omilu (*Caranx melampygus*) at 9 percent, down from 38 percent in 2001.

Table 37: Percent Discards From Bottomfish Trips with NMFS Observers, 1990–1993.

Species	No. Caught	No. Discarded	% Discarded
Kahala	2,438	2,266	92.9
Kalekale (yellowtail)	40	22	55
Sharks	176	92	52.3
Miscellaneous fish	115	59	51.3
Ulua (white)	127	62	48.8
Miscellaneous snapper/jack	189	91	48.1
Butaguchi	3,430	1,624	47.3
Ulua (black)	23	10	43.5
Tạape	110	40	36.4
Miscellaneous fish unidentified	174	26	14.9

Species	No. Caught	No. Discarded	% Discarded
Kalekale	874	52	6
Opakapaka	5,092	107	2.1
Ehu	1,185	20	1.7
Uku	2,209	28	1.3
Hapụupụu	1,593	19	1.2
Gindai	459	3	0.7
Onaga	1,141	8	0.7
Alfonsin	1	0	0
Armorhead	1	0	0
Lehi	3	0	0

Source: Nitta 1999.

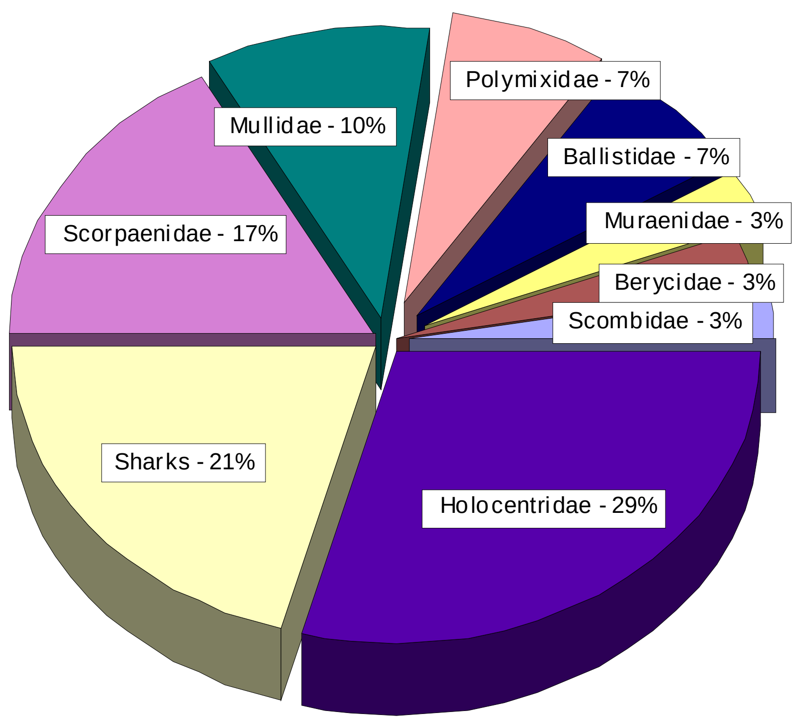


Figure 29: NMFS Research Cruise Estimates of Bottomfish Bycatch in Hawaii.
Note: Percent of total number; Source: WPRFMC 1998a.

In the Hoomalu Zone, several lesser valued species were commonly discarded, including kalekale (48 percent in 2002 and 24 percent in 2001), butaguchi (20 percent in 2002 and 32 percent in 2001) and white ulua (*C. ignoblis*; 63 percent in 2002, 70 percent in 2001). Tables 38 and 39 summarize information from the Mau and Hoomalu Zones, respectively for bycatch in 2002 and compare rates to those of 2001.

Table 38: Mau Zone Bycatch by Species in 2001 and 2002.

Species	No. Released in 2002	No. Sold in 2002	% Bycatch 2002	No. Released in 2001	% Bycatch in 2001
Pelagic MUS					
Shark	57	0	100	55	100
Tiger shark	3	0	100	1	100
Bottomfish MUS					
Ehu	2	2,070	<1	8	<1
Hapụupụu	12	1,254	1	0	0
Butaguchi	184	641	22	10	1
Black Ulua	2	81	2	0	0
Kahala	226	0	100	653	100
Miscellaneous Species					
̣Ōmilu	20	193	9	30	38
Barracuda	1	9	10	0	0

Table 39: Hoomalu Zone Bycatch by Species in 2001 and 2002.

Species	No. Released in 2002	No. Sold in 2002	% Bycatch 2002	No. Released in 2001	% Bycatch in 2001
Pelagic MUS					
Shark	8	0	100	34	100
Tiger shark	4	0	100	3	100
Bottomfish MUS					
̣Ōpakapaka	1	2206	<1	1	<1
Kalekale	439	474	48	264	24
Butaguchi	303	1248	20	767	32
White Ulua	221	128	63	532	70
Kahala	1610	0	100	3360	100
Miscellaneous Species					
̣Ōmilu	43	0	100	41	82

Source: PIFSC, unpublished data.

The Council’s supplement to the bycatch provisions of Amendment 6 (WPRFMC 2002b) includes four types of nonregulatory measures aimed at further reducing bycatch and bycatch mortality and improving bycatch reporting: (a) outreach to fishermen and engagement of fishermen in management, including research and monitoring, in order to raise their awareness of bycatch issues and of options to reduce bycatch; (b) research into fishing gear and method modifications to reduce bycatch and bycatch mortality; (c) research into the development of markets for discarded fish species; and (d) improvement of data collection and analysis systems to better measure bycatch.

3.4.7 Recreational Fishery

Statistics for this fishery are very limited; there are no requirements for saltwater fishing licenses or catch reporting for noncommercial fishermen in Hawaii and hence there is no system for collecting quality data. Over the years, occasional surveys have been fielded, but no systematic collection of noncommercial fisheries data has been sustained. The NMFS Marine Recreational Fisheries Statistical Survey, active in other parts of the country, collected data for a period ending about 20 years ago, but was discontinued in Hawaii. Recently, this program has returned to Hawaii as the Hawaii Marine Recreational Fishing Survey (HMRFS), and is collecting data using a dual survey approach consisting of random telephone surveys and a fisherman intercept survey conducted at boat launch ramps, small boat harbors, and shoreline fishing sites. To date, however, an insufficient number of intercepts of bottomfish fishermen have occurred to allow catch and effort determinations for this fishery.

The state's bottomfish fishing registration requirement, however, does offer one way to compare the commercial and noncommercial sectors of the fishery. Each applicant is required to specify commercial or noncommercial status. As of mid-2003, there were 3,194 vessels registered to fish for bottomfish in Hawaii. The breakdown for each island is shown in Table 40.

Table 40: Registered Commercial and Noncommercial Bottomfish Vessels by Island.

	Kauai	Oahu	Molokai	Lanai	Maui	Hawaii
Commercial	271	519	1	5	271	757
Non-commercial	109	921	25	16	107	174
Total by Island	380	1443	26	21	378	933
Total Commercial						1,824
Total Noncommercial						1,352
% Noncommercial by Island	28.7	63.8	96.2	76.2	28.3	18.6
Total % Noncommercial						42.6

Note. Source: HDAR presentation to WPRFMC.

Included in the state's 1998 bottomfish regulations was a control date for a possible future limited entry bottomfish fishery. Some fishermen registered to protect their right to participate in the bottomfish fishery if they should so choose in the future. Some others registered because it was not clear to them that reef fish were not included in the regulations. The proportions of respondents in these categories are not known, and it is not known whether they registered as commercial or noncommercial vessels. From Table 39, it appears that about 40 percent of the registered bottomfish fishing vessels in Hawaii are noncommercial. Registered vessels range in size from 8 feet to 65 feet in length. However, the vast majority of the registered vessels lie in the range 14 feet to 30 feet in length. The largest size class is 19 feet, with about 380 vessels represented (HDAR presentation to WPRFMC).

Recently, the HDAR surveyed Hawaii's registered bottomfish vessel owners by mail. The return rate was about 20 percent. Of the 722 completed questionnaires, only 38 percent said they actually fished for deep-water bottomfish in the previous year. Forty-eight percent said they sometimes fish for deep-water bottomfish, but hadn't done so during the previous year. Fourteen percent said they don't bottomfish at all. Forty-four percent had either electric or hydraulic bottomfish line pullers. 38 percent had GPS units and 46 percent had depth sounders. Of those who fished, most fished with another person (range one to five), fished two lines (range one to five) with, most often, five hooks per line (range one to thirteen). Bottomfish fishing effort varied cyclically over an annual cycle with most effort during November and December, and least effort during April and May. Weekends and holidays were the favored days for bottomfish fishing. State grid number 52 (331) was by far the preferred fishing area.

Two hundred and seventy-six of the respondents (38 percent) claimed commercial status, although not all had current licenses. If this proportion holds true for the entire database, then by this estimate, 62 percent of the registered vessels are noncommercial.

From these two estimates we can crudely estimate that about half the registered bottomfish fishing vessels are noncommercial. Landings of onaga and ehu by the noncommercial sector are now restricted to five total per person, but other species are not subject to catch limits. Nevertheless, it is likely those landings by noncommercial bottomfish vessels average much less than their commercial counterparts because of differences in vessel capability, fishing skill, and avidity. At this time it is not possible to estimate what the total noncommercial landings are. In the future, more bottomfish fisherman intercepts conducted in the HMRFS may provide this estimate.

3.5 Protected Species

Protected species include those species listed as endangered or threatened under the ESA, all marine mammals listed or not as they are protected under the Marine Mammal Protection Act (MMPA), and seabirds listed or not as they are protected under the Migratory Bird Treaty Act. Appropriate information on the species' life histories, habitats and distribution, and other factors necessary to their survival, is included in the Bottomfish FEIS and is incorporated here by reference. In particular, the status of the Hawaiian monk seal and potential interactions with the NWHI bottomfish fishery are extensively discussed in the FEIS. That material is incorporated here by reference and a summary of the species' current status is included below.

In March 2002, NMFS completed a formal consultation under ESA Section 7 and released its Biological Opinion (BiOp) for the Bottomfish FMP. The BiOp concluded that the bottomfish fisheries of the Western Pacific Region are not likely to jeopardize the continued existence of any threatened or endangered species under NMFS' jurisdiction, or destroy or adversely modify critical habitat that has been designated for them.

3.5.1 Marine Mammals

Protected marine mammals fall into two categories: species listed under the ESA and those species that are not listed but otherwise protected under the MMPA. Cetaceans and pinnipeds are discussed separately in the sections below.

3.5.1.1 Listed Cetaceans

There are six species of cetaceans listed under the ESA that occur within the area of operation of the bottomfish fishery of the Western Pacific Region. These species are the blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), sei whale (*Balaenoptera borealis*), sperm whale (*Physeter macrocephalus*), and right whale (*Eubalaena glacialis*).

Although these whales may be found within the action area and could interact with the U.S. fisheries of the Western Pacific Region, no reported or observed incidental takes of these species have occurred in the bottomfish fishery. Therefore, NMFS determined that there is no impact to these cetaceans from the bottomfish fishery.

3.5.1.2 Other Cetaceans

Species of marine mammals that are not listed under the ESA but are protected under the MMPA and occur in the areas of the Western Pacific Region where bottomfish fisheries operate are as follows:

- Blainsville beaked whale (*Mesoplodon densirostris*)
- Bottlenose dolphin (*Tursiops truncatus*)
- Bryde's whale (*Balaenoptera edeni*)
- Cuvier's beaked whale (*Ziphius cavirostris*)
- Dwarf sperm whale (*Kogia simus*)
- False killer whale (*Pseudorca crassidens*)
- Killer whale (*Orcinus orca*)
- Melon-headed whale (*Peponocephala electra*)
- Pygmy killer whale (*Feresa attenuata*)
- Pygmy sperm whale (*Kogia breviceps*)
- Risso's dolphin (*Grampus griseus*)
- Rough-toothed dolphin (*Steno bredanensis*)
- Short-finned pilot whale (*Globicephala macrorhynchus*)
- Spinner dolphin (*Stenella longirostris*)
- Spotted dolphin (*Stenella attenuata*)
- Striped dolphin (*Stenella coeruleoalba*)
- Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)
- Minke whale (*Balaenoptera acutorostrata*)

- Dall’s porpoise (*Phocoenoides dalli*)
- Fraser’s dolphin (*Lagenodelphis hosei*)
- Longman’s beaked whale (*Indopacetus pacificus*)

Of the above species, the bottomfish fishery has been documented to interact with only one species, the bottlenose dolphin (*Tursiops trucatus*; Nitta and Henderson 1993). Although the other species listed above may be found within the action area and could interact with bottomfish fisheries in the Western Pacific Region, no reported or observed incidental takes of these species have occurred in these fisheries. Therefore, NMFS determined that the bottomfish fishery is not likely to adversely affect these cetaceans. Although bottlenose dolphins have been observed stealing hooked fish off of bottomfish lines, the extent of such interactions are not known, but believed to be low. The impact of the bottomfish fishery on the behavior or foraging success of bottlenose dolphins is unknown, but not believed to be adverse.

3.5.1.3 Listed Pinniped: The Hawaiian Monk Seal

The following, which was taken from the Hawaiian Monk Seal Recovery Plan (2005), summarizes the current status of the Hawaiian monk seal (*Monachus schauinslandi*).

> *The Hawaiian monk seal was listed as an endangered species under the ESA on November 23, 1976 (FR 51612) and remains listed as endangered. Based on recent counts the current population is approximately 1300 individuals. Most of the Hawaiian monk seal population is distributed throughout the NWHI in six main reproductive subpopulations at FFS, Laysan and Lisianski Islands, Pearl and Hermes Reef, and Midway and Kure Atolls. Small numbers also occur at Necker, Nihoa, and the MHI, primarily at Niihau. Initial studies of genotypic variation (Kretzmann et al. 1997) suggest that the species is characterized by low genetic variability, minimal genetic differentiation among subpopulations and, perhaps, some naturally occuring local inbreeding. Seals have been observed on each of the main eight islands. There were at least 45 seals in the MHI in 2000 and at least 52 in 2001, based on aerial surveys of all MHI coastlines supplemented by sightings of seals from the ground (Baker and Johanos, 2004). Moreover, annual births in the MHI have evidently increased since the mid-1990s. It is possible that Hawaiian monk seals may be re-colonizing the MHI, which may have been part of their historic range. Regardless, the MHI habitat appears to be favorable for continued increases of this endangered species. Identified threats to the survival of the Hawaiian monk seal include, but are not limited to, habitat degradation, marine debris entanglement, human disturbance, disease, shark predation, vessel groundings, and interactions with fisheries.*

3.5.1.4 Other Pinniped: The Northern Elephant Seal

Although uncommon in the action area of the bottomfish fishery, the northern elephant seal (*Mirounga angustirostris*) has been observed in the MHI and the NWHI. In 2002 a yearling appeared on the island of Hawaii, was captured, and transported to the Marine Mammal Center in California for rehabilitation and reintroduction to the wild.

Although this species may occasionally be found within the action area and could interact with the U.S. fisheries of the Western Pacific Region, no reported or observed incidental takes of this species have occurred in the bottomfish fishery. There is no current expectation of future interactions between this species and the bottomfish fishery and therefore, this species will not be considered further in this document.

3.5.2 Sea Turtles

All sea turtles are designated as either threatened or endangered under the ESA. The five species of sea turtles known to be present in the region in which bottomfish vessels operate are: the leatherback (*Dermochelys coriacea*), the olive ridley (*Lepidochelys olivacea*), the hawksbill *(Eretmochelys imbricata*), the loggerhead (*Caretta caretta*), and the green turtle (*Chelonia mydas*).

Leatherback turtles and hawksbill turtles are classified as endangered. The breeding populations of Mexico olive ridley turtles are currently listed as endangered, while all other olive ridley populations are listed as threatened. The loggerhead turtles and the green turtles are listed as threatened (note that the green turtle is listed as threatened under the ESA throughout its Pacific range, except for the endangered population nesting on the Pacific coast of Mexico).

Leatherbacks have the most extensive range of any living reptile and have been reported circumglobally from latitudes 71°N to 42°S in the Pacific and in all other major oceans. The diet of the leatherback turtle generally consists of cnidarians (i.e. medusae and siphonophores) in the pelagic environment. They lead a completely pelagic existence, foraging widely in temperate waters except during the nesting season, when gravid females return to beaches to lay eggs. Typically, leatherbacks are found in convergence zones and upwelling areas in the open ocean, along continental margins, and in archipelagic waters.

The loggerhead turtle is a cosmopolitan species found in temperate and subtropical waters and inhabiting continental shelves, bays, estuaries and lagoons. Major nesting grounds are generally located in warm temperate and subtropical regions, generally north of 25°N or south of 25°S latitude in the Pacific Ocean. For their first several years of life, loggerheads forage in open ocean pelagic habitats. Both juvenile and subadult loggerheads feed on pelagic crustaceans, mollusks, fish and algae. As they age, loggerheads begin to move into shallower waters, where, as adults, they forage over a variety of benthic hard and soft bottom habitats.

The olive ridley is one of the smallest living sea turtles (carapace length usually between 60 and 70 cm) and is regarded as the most abundant sea turtle in the world. Since the directed take of sea turtles was stopped in the early 1990s, the nesting populations in Mexico seem to be recovering, with females nesting in record numbers in recent years. The olive ridley turtle is omnivorous and identified prey include a variety of benthic and pelagic items such as shrimp, jellyfish, crabs, snails, and fish, as well as algae and sea grass.

The hawksbill turtle is rapidly approaching extinction in the Pacific, primarily due to the harvesting of the species for its meat, eggs, and shell, as well as the destruction of nesting habitat. Hawksbills have a relatively unique diet of sponges.

Green turtles in Hawaii are genetically distinct and geographically isolated, which is uncharacteristic of other regional sea turtle populations. Both nesting and foraging populations of green turtles in Hawaii appear to have increased over the past 20 years. In Hawaii, green turtles nested historically on beaches throughout the archipelago, but now nesting is restricted primarily to beaches in the NWHI. More than 90 percent of the Hawaiian population of the green turtle nests at FFS. Satellite tagging of these animals indicates that most of them migrate to the MHI to feed, and then return to breed. The four other species of sea turtles are seen in the waters of the NWHI only on rare occasions.

3.5.3 Seabirds

Although there are several seabird colonies in the MHI, the NWHI colonies harbor more than 90 percent of the total Hawaiian Archipelago seabird population. The NWHI provide most of the nesting habitat for more than 14 million Pacific seabirds. More than 99 percent of the world's laysan albatross (*Phoebastria immutabilis*) and 98 percent of the world's black-footed albatross (*P. nigripes*) return to the NWHI to reproduce. Of the 18 species of seabirds recorded in the NWHI, only the short-tailed albatross (*P. albatrus*) is listed as endangered under the ESA. The short-tailed albatross population is the smallest of any of the albatross species occurring in the North Pacific. Land-based sighting records indicate that 15 short-tailed albatrosses have visited the NWHI over the past 60 years. Five of these visits were between 1994 and 1999 (NMFS 1999).

3.5.4 Bottomfish Fisheries Interactions with Protected Species

Since October 2003, the Hawaii-based bottomfish fishery has been monitored under a mandatory observer program. Data for seven calendar quarters are available on the PIRO website. During this time, observer coverage has averaged 21.4 percent. There have been no observed interactions with sea turtles or marine mammals. There have been a total of six seabird interactions, including two unidentified boobies, one brown booby, one black-footed albatross and two Laysan albatrosses. Only the black-footed albatross interaction occurred during bottomfish fishing operations. All of the other interactions were observed in transit during trolling operations.

3.6 Economic, Social, and Cultural Setting

3.6.1 Hawaii Overview

Income generation in Hawaii is characterized by tourism, federal defense spending and, to a lesser extent, agriculture. Tourism is by far the leading industry in Hawaii in terms of generating jobs and contributing to gross state product. The World Travel and Tourism Council (1999) estimated that tourism in Hawaii directly generated 134,300 jobs in 1999. This figure represents 22.6 percent of the total workforce.

For 2002, Hawaii Department of Business, Economic Development and Tourism estimated that direct and indirect visitor contribution to the state economy was 22.3 percent. A bit less than half of that (10.2 percent) was generated in Waikiki. Total visitor expenditures in Hawaii were $9,993,775,000. Tourism's direct and indirect contribution to Hawaii's gross state product in 2002 was estimated at $7,974,000,000, or 17.3 percent of the total. Directly and indirectly, tourism accounted for 22.3 percent of all civilian jobs, and 26.4 percent of all local and state taxes.

Department of Defense expenditures in Hawaii in 2002 were $4,293,459,000. Defense expenditures in Hawaii are expected to increase significantly in the near future. These expenditures fall into two broad categories: monies for the pending arrival of the Stryker force, which requires changes in facilities and additional facilities; and the renovation of old military housing as well as the construction of new military housing. As of late July 2004, Hawaii is expected to receive $496.7 million in defense-related spending. When combined with funds earmarked for construction that are contained in a measure before the Senate, Hawaii stands to receive more than $865 million in defense dollars, not including funds for day to day operations or payroll (Inouye 2004).

Agricultural products include sugarcane, pineapples (which together brought in $269.2 million in 1997), nursery stock, livestock, and macadamia nuts. In 2002, agriculture generated a total of $510,672,000 in sales. Agricultural employment decreased from 7,850 workers in 2000 to 6,850 in 2003. This change may be due to the increasing use of lots zoned for agriculture for construction of high-end homes, a trend that is evident throughout the state.

Table 41 summarizes trends in Hawaii's gross state product by industry. The fishing industry is lumped together with agriculture, forestry, and hunting. That sector of the economy generated $383 million in 2003.

Table 41: Hawaii Gross State Product by Industry, 1997–2003 ($Million).

Industry	1997	1998	1999	2000	2001	2002	2003
Total, all industries	37,546	37,614	38,702	40,176	41,720	43,806	46,671
Private industries total	29,254	29,267	30,128	31,480	32,636	33,886	36,088
Agriculture, forestry, fishing, and hunting	363	359	374	365	347	372	383
Mining	17	16	17	18	17	15	17
Utilities	868	859	860	829	876	819	878
Construction	1,687	1,662	1,627	1,817	1,911	2,099	2,329
Manufacturing	858	823	835	838	811	784	842
Wholesale trade	1,331	1,320	1,360	1,372	1,444	1,530	1,640
Retail trade	2,955	2,849	2,903	3,018	3,144	3,302	3,544
Transportation & warehousing	1,621	1,632	1,748	1,847	1,892	1,640	1,623
Information	1,149	1,189	1,262	1,328	1,340	1,283	1,303
Finance and insurance	1,770	1,679	1,670	1,863	1,938	2,062	2,176

Industry	1997	1998	1999	2000	2001	2002	2003
Real estate, rental, and leasing	6,154	6,219	6,555	6,674	6,993	7,334	7,806
Professional and technical services	1,634	1,671	1,669	1,710	1,856	1,983	2,155
Management of companies and enterprises	463	466	457	431	406	483	508
Administrative and waste services	959	974	1,073	1,166	1,261	1,405	1,541
Educational services	355	366	373	403	417	443	466
Health care and social assistance	2,372	2,471	2,517	2,666	2,838	2,986	3,216
Arts, entertainment, and recreation	485	493	488	492	508	552	574
Accommodation and food services	3,197	3,150	3,264	3,560	3,507	3,638	3,861
Other services	1,016	1,069	1,075	1,082	1,128	1,156	1,226
Government total	8,292	8,347	8,574	8,696	9,085	9,921	10,582

Source: DBEDT 2004

The latest economic trends analysis (Bank of Hawaii, October 2005) concluded the following:

> Strong Hawaii employment data through August 2005 confirm recently reported first half Honolulu inflation, yielding strong Hawaii real personal income growth, suggesting that good economic momentum continued into third quarter 2005. Flattening summer tourism numbers against seasonal capacity constraints, combined with a stronger dollar and continued travel cost pressure from rising fuel costs, support the forecast of slower visitor arrivals growth going into 2006. As noted with last month's semiannual construction forecast revisions, construction growth is also expected to slow during 2006 because of completion of the military construction ramp-up and decreases in private authorizations. But strong overall economic growth should spill over from 2005 to 2006 for Hawaii, with only a modest slowing in the local expansion's pace.

3.6.1.1 Fishing-Related Economic Activities

The harvest and processing of fishery resources play a minor role in Hawaii's economy. The most recent estimate of the contribution of the commercial, charter and recreational fishing sectors to the state economy indicated that in 1992, these sectors contributed $118.79 million of output (production), $34.29 million of household income, and employed 1,469 people (Sharma et al. 1999). These contributions accounted for only 0.25 percent of total state output ($47.4 billion), 0.17 percent of household income ($20.2 billion), and 0.19 percent of employment (757,132 jobs). However, in contrast to the sharp decline in some traditional mainstays of Hawaii's economy such as large-scale agriculture, the fishing industry has been fairly stable during the past decade. Total revenues in Hawaii's pelagic, bottomfish, and lobster fisheries in 1998 were about 10 percent higher than 1988 revenues (adjusted for inflation) in those fisheries.

Hawaii's commercial fishing sector includes a wide array of fisheries. The Hawaii longline fishery is by far the most important economically, accounting for 73 percent of the estimated ex-vessel value of the total commercial fish landings in the state in 1999 (Table 42). As shown in that table, the NWHI and MHI bottomfish fisheries account for a relatively small share of the landings and value of the state's commercial fisheries.

Table 42: Volume and Value of Commercial Fish Landings in Hawaii by Fishery, 1999.

Fishery	Pounds Landed (1,000s)	Percent of Total Pounds Landed	Ex-vessel Value ($1,000s)	Percent of Total Ex-vessel Value
Pelagic longline	28,300	75%	47,400	73%
Troll	2,960	8%	4,550	7%
Pelagic handline	2,340	6%	3,950	6%
Aku pole and line	1,450	4%	1,850	3%
MHI bottomfish handline	420	1%	1,300	2%
NWHI bottomfish handline	370	1%	1,210	2%
NWHI lobster trap	260	1%	1,040	2%
All other fisheries	1,650	4%	3,330	5%
Total	37,750	100%	64,630	100%

Source: Data compiled by PIFSC.

Another perspective on the role of bottomfish in Hawaii is to compare landings with pelagic, reef fish, and other fish. Table 43 shows the changing patterns from 2000 to 2003 (National Marine Fisheries Service 2004).

Table 43: Annual Estimated Commercial Landings in Hawaii (1,000 lbs), 2000–2003.

Year	Pelagic Fish	Bottomfish	Reef Fish	Other Fish
2000	26,763	718	199	957
2001	22,011	660	250	591
2002	22,330	621	345	662
2003	21,993	602	315	661

Estimates of the economic activity in the various sectors (commercial, charter, and recreational) of Hawaii's bottomfish fishery can be obtained from various published data. According to the Western Pacific Regional Fishery Management Council (1999), for the period 1994 to 1998, the ex-vessel value of annual commercial landings in the NWHI and MHI bottomfish fisheries averaged about $1,096,200 and $1,625,800, respectively. Based on data collected in a recent cost-earnings study of Hawaii's charter fishing industry (Hamilton 1998), it is estimated that the charter boat fleet earns about $342,675 per year from taking patrons on bottomfish fishing trips. Finally, based on information gathered in a recent cost-earnings study of Hawaii's small boat fishery (Hamilton and Huffman 1997), it is estimated that annual personal consumption expenditures for recreational vessels engaged in bottomfish fishing total about $2,827,096. Recreational vessels are fishing boats that do not sell any portion of their catch.

However, the above values reflect only the direct revenues and expenditures in the various sectors of the bottomfish fishery. They do not take into account that employment and income are also generated indirectly within the state by commercial, recreational, and charter fishing for bottomfish. The fishery has an economic impact on businesses whose goods and services are used as inputs in the fishery, such as fuel suppliers, chandlers, gear manufacturers, boatyards, tackle shops, ice plants, bait shops, and insurance brokers. In addition, the fishery has an impact on businesses that use fishery products as inputs for their own production of goods and services. Firms that buy, process, or distribute fishery products include seafood wholesale and retail dealers, restaurants, hotels, and retail markets. Both the restaurant and hotel trade and the charter fishing industry are closely linked to the tourism base that is so important to Hawaii's economy. Finally, people earning incomes directly or indirectly from the fishery make expenditures within the economy as well, generating additional jobs and income.

A more accurate assessment of current contributions of the bottomfish fishery to the economy can be obtained using the Type II output, income and employment multipliers calculated by Sharma et al. (1999) for Hawaii's (non-longline) commercial, charter and recreational fishing sectors. Applying these multipliers to an approximation of the final demand in each of the sectors involved in bottomfish fishing, it is estimated that this fishing activity contributes $10.78 million of output (production) and $2.51 million of household income to the state economy and creates the equivalent of 113 full-time jobs (Table 44).

Table 44: Estimated Output, Household Income, and Employment Generated by Bottomfish Fishing Activity in Hawaii.

Fishery	Sales ($)	Final Demand ($)	Output ($)	Household Income ($)	Employment (jobs)[1]
NWHI bottomfish fishery					
Commercial vessels[2]	1096200	580,986	1,382,747	482,218	25
MHI bottomfish fishery					
Commercial vessels[2]	1625800	861,674	2,050,784	715,189	36
Charter vessels[3]	305664	293,437	760,002	269,962	14
Recreational vessels[4]		2,827,096	6,587,134	1,046,026	38
Total			10,780,667	2,513,431	113

[1] Calculated as full-time jobs. The input–output model assumes that fishing accounts for 20 percent of the employment time of part-time commercial fishermen (Sharma et al. 1999).
[2]Average annual sales estimate for 1994–1998 from Western Pacific Regional Fishery Management Council (1999). [3]Sales estimate based on the following assumptions: 199 active vessels; average annual sales of $76,800 per vessel from charter fees and mount commissions; and two percent of total sales attributed to bottomfish fishing trips (Hamilton 1998).
[4]Expenditure estimates based on the following assumptions (Hamilton and Huffman 1997; Pan et al. 1999):

Number of recreational boats	2,490
Annual number of bottomfish fishing trips	3.81
Average trip costs	84.75
Average fixed costs: apportioned according to ratio of bottomfish fishing trips to total number of trips	213

3.6.2 Fishing Communities

The 1996 SFA amendments to the MSA added a definition of "fishing community" (MSA §(16)) and required that fishing communities be considered in the fishery impact statement (§303(a)(9)) and in certain other contexts, such as any proposal for limited access to a fishery (§303(b)(6)) and any plan to end overfishing (§304(e)(4)).

The MSA defines "fishing community" (§3(16)):

The term "fishing community means a community which is substantially dependent on or substantially engaged in the harvest or processing of fishery resources to meet social and economic needs, and included fishing vessel owners, operators, and crew and U.S. fish processors that are based in such community.

The SFA also added National Standard 8 (§301(a)(8)), which states the following:

Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and the rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (a) provide for the sustained participation of such communities and (b) to the extent practicable, minimize adverse economic impacts on such communities.

The National Standard Guidelines further specify that (50 CFR 600.345):

A fishing community is a social or economic group whose members reside in a specific location and share a common dependency on commercial, recreational, or subsistence fishing or on directly related fisheries-dependent services and industries (e.g. boatyards, ice suppliers, tackle shops).

And furthermore:

The term “sustained participation” means continued access to the fishery within the constraints of the condition of the resource.

To address the requirements of the SFA, the Council prepared a comprehensive document with amendments to all four of its FMPs. Amendment 6 to the Bottomfish FMP, Amendment 8 to the Pelagics FMP, Amendment 10 to the Crustaceans FMP, and Amendment 4 to the Precious Corals FMP were published in September 1998 and submitted to NMFS for review. NMFS only partially approved the amendments, as described in a *Federal Register* notice published on April 19, 1999 (64 FR 19067). Three components of the amendments were disapproved: the bycatch provisions (MSA §301(a)(9), §303(a)(11), and other sections) for the Bottomfish and Pelagics FMPs, the overfishing provisions (§303(a)(10) and other sections) for the Bottomfish, Pelagics, and Crustaceans FMPs, and for all four FMPs, the description of the State of Hawaii as a single fishing community (MSA §301(a)(8), §303(a)(9), and other sections).

The Council prepared and submitted supplements to the amendments to address the disapproved sections of Bottomfish FMP Amendment 6, Pelagic FMP Amendment 8, Crustaceans FMP Amendment 10, and Precious Corals Amendment 4 regarding the identification of fishing communities. The fishing communities supplement (WPRFMC 2002c) reconsidered the original identifications and identified a new set of fishing communities within Hawaii. It provided additional background and analysis to justify those identifications. It does not modify the identification of American Samoa, the Northern Mariana Islands, and Guam as fishing communities, as these definitions were approved in the original SFA amendments.

With respect to Hawaii, the findings indicated that fishing and related services and industries are important to all of Hawaii’s inhabited islands that the social and economic cohesion of fishery participants is particularly strong at the island level, and that fishing communities are best not distinguished according to fishery or gear type. The most logical unit of analysis for describing the community setting and assessing community-level impacts is the island. In each of the four FMP amendments, each of the islands of Kauai, Niihau, Oahu, Maui, Molokai, Lanai, and Hawaii is identified as a fishing community for the purposes of assessing the effects of fishery conservation and management measures on fishing communities, providing for the sustained participation of such communities, minimizing adverse economic impacts on such communities, and for other purposes under the MSA. These definitions were subsequently approved by NMFS.

The social analysis provided in this section is driven by the SFA requirement that impacts to fishing communities be considered in the context of fishery management decisions and by the NEPA requirement that the social and cultural effects of alternatives be discussed (40 CFR 1508.8). Section 3.6 of this EIS provided an overview of the standard socioeconomic variables typically found in an EIS, including a summary of income and employment data for the affected area. The present section includes data on population size and ethnicity and a description of the sociocultural setting of the bottomfish fisheries in the Western Pacific Region.

The sociocultural aspects of a fishery include the shared technology, customs, terminology, attitudes and values related to fishing. While it is the fishermen that benefit directly from the fishing lifestyle, individuals who participate in the marketing or consumption of fish or in the provision of fishing supplies may also share in the fishing culture. An integral part of this framework is the broad network of interpersonal social and economic relations through which the cultural attributes of a fishery are transmitted and perpetuated. The relations that originate from a shared dependence on fishing and fishing-related activities to meet economic and social needs can have far-reaching effects in the daily lives of those involved. For example, they may constitute important forms of social capital, that is, social resources that individuals and families can draw on to help them achieve desired goals.

The products of fishing supplied to the community may also have sociocultural significance. For instance, beyond their dietary importance fish may be important items of exchange and gift giving that also help develop and maintain social relationships within the community. Alternatively, at certain celebratory meals various types of seafood may become imbued with specific symbolic meanings.

Finally, the sociocultural context of fishing may include the contribution fishing makes to the cultural identity and continuity of the broader community or region. As a result of this contribution the activity of fishing may have existence value for some members of the general public. Individuals who do not fish themselves and are never likely to fish may derive satisfaction and enjoyment from knowing that these fisheries exist. They may value the knowledge that the traditions, customs and life ways of fishing are being preserved.

3.6.2.1 Population Size and Ethnicity

The 1990 census listed the population of Hawaii as 1,108,229. This figure rose to 1,179,198 in 1995 and to 1,211,537 in 2000. The population increased by a rate of 6.9 percent between 1990 and 1999.

The state of Hawaii is divided into five counties. The county of Maui includes the islands of Kahoolawe, Lanai, Maui and Molokai. The county of Honolulu encompasses the island of Oahu and the Northwestern Hawaiian Islands excluding Midway Atoll. Kauai County consists of the islands of Kauai and Niihau. The population of each county is provided in Table 45.

Table 45: Hawaii Population by County.

Area	1990 Census	2000 Census
Hawaii State	1,108,229	1,211,537
Honolulu County, HI	836,231	874,154
Hawaii County, HI	120,317	148,677
Kauai County, HI	51,177	584,63
Maui County, HI	100,374	128,094

Source: U.S. Census Bureau.

The 2000 Census redefined the way race is measured in a number of ways, allowing individuals to identify themselves as one race or a combination of races, as well as having a separate classification system for Hispanic or Latino and race. As a result, describing the makeup of Hawaii's population is more complex. Perhaps the most accurate way to describe Hawaii's population is to report the proportions of race alone or in combination with one or more other races. In 2000, 39.3 percent of Hawaii residents described themselves as white, 2.8 percent as black or African American, 2.1 percent as American Indian or Alaska native, 58 percent as Asian, 23.3 percent as native Hawaiian and other Pacific Islander, and 3.9 percent as some other race. These proportions add up to more than 100 percent because many individuals reported more than one race. Of the 78.6 percent of residents who reported just one race, 24.5 percent listed White, 1.8 percent Black or African American, 41.6 percent Asian (including 4.7 percent Chinese, 14.1 percent Filipino, 16.7 percent Japanese, 1.9 percent Korean, and 0.6 percent Vietnamese), and 9.4 percent Native Hawaiian and other Pacific islander.

In 1995 and 1996, Hamilton and Huffman (1997) conducted a survey of small-boat owners who engage in Hawaii's commercial and recreational fisheries, including the troll, pelagic handline and bottomfish handline fisheries. The survey found that the three largest ethnic groups represented in the sample were Japanese (33 percent), mixed with part Hawaiian (16 percent) and Caucasian (12 percent). Hamilton and Huffman (1997) speculated that the high proportion of Japanese and part Hawaiians in the sample reflects the traditional connections that these two ethnic groups have with the sea. These sociocultural connections are discussed further in the following section.

With specific regard to the NWHI bottomfish fishery, a 1993 survey of 15 owner-operators and hired captains who participate in the fishery found that 87 percent were Caucasian and 13 percent were part Hawaiian (Hamilton 1994). However, it is likely that the ethnic composition of the deckhands aboard these vessels is much more mixed and reflects the highly diverse ethnic character of the state's total population

3.6.2.2 Sociocultural Setting

Over the past 125 years, the sociocultural context of fishing in Hawaii has been shaped by multiethnic participants in local fisheries. Although certain ethnic groups have predominated in Hawaii's fisheries in the past and ethnic enclaves continue to exist within certain fisheries, the fishing tradition in Hawaii is generally characterized by a partial amalgamation of multicultural attributes. An examination of the way in which the people of Hawaii harvest, distribute and consume seafood reveals remnants of the varied technology, customs and values of Native Hawaiians and immigrant groups from Japan, China, Europe, America, the Philippines, and elsewhere.

3.6.2.3 Social Aspects of Fish Harvest

Commercial fishing first became important in the Hawaiian Islands with the arrival of the British and American whaling fleets during the early nineteenth century. The whalers made the islands their provisioning and trading headquarters because of their central location in the Pacific (Nakayama 1987). This trade reached its zenith in the 1850s when more than 400 whaling vessels arrived in Honolulu annually (Shoemaker 1948). European- and American-owned trading concerns, called “factors,” were established to service the whalers and gradually became the dominant enterprises in Honolulu. The significance of whaling to Hawaii’s economy waned considerably during the late nineteenth century by which time plantation agriculture centered on sugar and pineapple production had grown in importance. A number of the trading companies that supported the whaling industry, however, adjusted to these economic changes and remained at the heart of Hawaii’s industrial and financial structure (Shoemaker 1948).

The introduction of a cash economy into Hawaii and the establishment of communities of foreigners in the islands also led to the development of a local commercial fishery. As early as 1832, it was the custom for fish and other commodities to be sold in a large square near the waterfront in Honolulu (Reynolds 1835). In 1851, the first regular market house for the sale of fishery products was erected (Cobb 1902). The territorial government replaced this market in 1890 with an elaborate structure that Cobb (1902, p. 435) referred to as “one of the best [market houses] in the United States.” Other fish markets were established on the islands of Maui and Hawaii. Locally caught bottomfish were in high demand at these markets. In Bryan’s (1915) list of seafood preferences by the various “nationalities” in Hawaii, all of the bottomfish species listed (i.e., hāpuʻupuʻu, kāhala, ʻōpakapaka and uku) were among the types of fish purchased by all social groups. Bryan (1915, p. 371) noted that some of the snappers “may be procured almost every day, there being more than a hundred thousand pounds sold annually in the Hawaiian markets.” Jordan and Evermann (1902) wrote of uku: “This fish is common about Honolulu, being brought into the market almost every day. It is one of the best of food-fishes.” Gindai is also referred to as “one of our best food fishes” by Brigham (1908, Cobb (1902) reported that ʻulaʻula, uku, and ulua were among the five species of fish taken commercially on all the islands. Titcomb (1972) wrote that ʻōpakapaka was one of the most common fish on restaurant menus prior to World War II.

Initially, commercial fishing in Hawaii was monopolized by Native Hawaiians, who supplied the local market with fish using canoes, nets, traps, spears, and other traditional fishing devices (Cobb 1902; Jordan and Evermann 1902; Konishi 1930). However, the role that Native Hawaiians played in Hawaii’s fishing industry gradually diminished through the latter half of the nineteenth century. During this period, successive waves of immigrants of various races and nationalities arrived in Hawaii, thus increasing the non-indigenous population from 5,366 in 1872 to 114,345 in 1900 (Office of Hawaiian Affairs 1998). The new arrivals included Americans, Chinese, Portuguese, and Filipinos, but particularly significant in terms of having a long-term impact on the fishing industry was the arrival of a large number of Japanese. The Japanese, like the majority of the early immigrants, were contracted to work on Hawaii’s sugarcane plantations. When contract terms expired on the plantations, many of the Japanese immigrants who had been skilled commercial fishermen from the coastal areas of Wakayama, Shizuoka, and Yamaguchi Prefectures in Japan turned to the sea for a living (Okahata 1971). Later, experienced fishermen came from Japan to Hawaii for the specific purpose of engaging in commercial fishing. The bottomfish fishing gear and techniques employed by the Japanese immigrants were slight modifications of those traditionally used by Native Hawaiians.

During much of the twentieth century, Japanese immigrants to Hawaii and their descendants were preeminent in Hawaii’s commercial fishing industry. The tightly knit communities that the first Japanese immigrants formed both helped ease the transition to American society and retarded the process of acculturation (Tamura, 1994). The Japanese were able to maintain their separate communities in Hawaii more effectively than any other immigrant group. Among those Japanese communities of particular significance were the settlements of commercial fishermen and their families in the Palama, River Street, and Kākāʻāko areas of Honolulu adjacent to the harbor (Lind 1980).

The adherence of Japanese immigrants to traditional cultural practices included Japanese religious observances, and many of the religious activities of communities such as Kākāʻāko were centered on fishing (Miyasaki 1973). Various traditional Japanese taboos and rituals directed how a new fishing boat was to be launched, when a vessel could leave or return to port, what items could be brought on board a boat, and many other aspects of fishing behavior (Hamamoto 1928; Katamoto 1984). Over the years, succeeding generations of fishermen of Japanese ancestry in Hawaii became more “Americanized,” but many Japanese fishing traditions persisted. For example, Japanese immigrant fishermen brought from Japan the Shinto practice of building a jinsha (shrine) dedicated to a deity such as Konpira-sama or Ebisu-sama (Kubota 1984; Miyasaki 1973). Today, an Ebisu jinsha constructed at Maalaea on the island of Maui during the early 1900s still stands, and fishermen of Japanese ancestry as well as others who share a common bond in fishing continue each year to ceremonially bless individual fishing vessels (Kubota 1984; T. Arine, personal communication 2000. Maui Jinsha).

In addition to ethnic and community ties, the physical danger of fishing as an occupation also engendered a sense of commonality among fishermen. Describing the captains and crews of the early sampan fleet in Hawaii, Okahata (1971, p. 208) wrote the following: “It is said that the fishermen were in a clan by themselves and were imbued with a typical seaman’s reckless daring spirit of ‘death lies only a floor board away.’” The extreme isolation of the NWHI and the limited shelter they offered during rough weather made fishing trips to these islands particularly hazardous. The perils of fishing in the NWHI for bottomfish and other species captured the attention of the public media (e.g. Inouye 1931; Lau 1936).

As late as the 1970s, the full-time professional fishermen in Hawaii were predominately of Japanese descent (Garrod and Chong 1978). However, by that period hundreds of local residents of various ethnicities were also participating in Hawaii’s offshore fisheries as part-time commercial and recreational fishermen. In addition, a growing number of fishermen from the continental United States began relocating to Hawaii. Many of the new arrivals came to the islands because declining catch rates in some mainland fisheries had led to increasingly restrictive management regimes.

Today, the people who participate in Hawaii’s bottomfish fishery and other offshore fisheries make up an ethnically mixed and spatially dispersed group numbering several hundred individuals, although actual numbers are difficult to ascertain. Most are year-round residents of Hawaii, but some choose to maintain principal residences elsewhere. Participants in the bottomfish fishery do not reside in a specific location and do not constitute a recognizable fishing community in any geographical sense of the term. There are a few rural villages in the state where most residents are at least partially economically dependent on fishing for pelagic species (Glazier 1999). In general, however, those who are dependent on or engaged in the harvest of fishery resources to meet social and economic needs do not include entire cities and towns, but subpopulations of metropolitan areas and towns. These subpopulations make up fishing communities in the sense of social groups whose members share similar lifestyles associated with fishing.

Most of the vessels that participate in the NWHI bottomfish fishery utilize harbor facilities at Kewalo Basin, a harbor located in the metropolitan Honolulu area. Three vessels operate from Port Allen Harbor on Kauai. Nearly all of the participants in the NWHI bottomfish fishery reprovision in Honolulu and offload their catch at the fish auction. In addition, most of the large-volume, restaurant-oriented wholesalers that buy, process, and distribute fishery products are located in the greater Honolulu area. Businesses whose goods and services are used as inputs in Hawaii’s offshore commercial fisheries, such as ice plants, marine rail ways, marine suppliers, welders, and repair operations, are similarly concentrated in Honolulu. However, the contribution of the harvesting and processing of fishery resources to the total economic fabric of Honolulu is negligible in comparison to other economic activities in the metropolitan area, such as tourism. In other words, Honolulu is the center of a major portion of commercial fishing-related activities in the state, but it is not a community substantially dependent upon or substantially engaged in fisheries in comparison to its dependence upon and engagement in other economic sectors.

The bottomfish fishing fleet that concentrates its effort in the waters around the MHI consists mainly of vessels trailer operating from numerous launching facilities scattered throughout the state (Hamilton and Huffman, 1997). Glazier (1999) identified 55 ramps and harbors used by commercial and recreational fishing boats. This number does not include several private boat mooring and launching facilities. Many of these harbors and ramps offer minimal shore-side support services, and even some of the large, well-developed harbors are remote from any central business district or residential area. However, the extensive network of launching sites provides fishermen living anywhere on a given island ready access to multiple fishing grounds (Glazier, 1999).

The motivations for fishing among contemporary Hawaii fishermen tend to be mixed even for a given individual (Glazier 1999). In the small boat fishery around the MHI, the distinction between “recreational” and “commercial” fishermen is extremely tenuous (Pooley 1993a). Hawaii’s seafood market is not as centralized and industrialized as U.S. mainland fisheries, so it has always been feasible for small-scale fishermen to sell any or all of their catch for a respectable price. Money earned from part-time commercial fishing is an important supplement to the basic incomes of many Hawaii families.

It is also important to note that many people in Hawaii who might be considered commercial fishermen hold non-fishing jobs that contribute more to their household income than does fishing (Pooley 1993a). For some fishermen, non-fishing jobs are not a choice, but a necessity because of the inability to earn an adequate return from fishing. Many participants in Hawaii’s offshore fisheries often catch insufficient fish to cover even fuel, bait, and ice expenses, but they continue fishing simply for the pleasure of it. Some go so far as to pursue non-fishing occupations that allow them to maximize the time they can spend fishing regardless if it is profitable or not (Glazier 1999).

Even those fishermen who rely on fishing as their primary source of income have other reasons for their occupational choice besides financial gain. For example, a 1993 survey of owner–operators and hired captains who participate in the NWHI bottomfish fishery found that enjoyment of the lifestyle or work itself is an important motivation for fishing among fishery participants (Table 46).

Table 46: Motivations of 1993 Active Vessel Captains and Owners in the NWHI Bottomfish Fishery.

Motivation	**Mau Zone**						**Hoomalu Zone**	
	Owner-operated vessels *N* = 5		Hired captain vessels *N* = 3				All vessels *N* = 4	
			Captain		Owner			
	Most Important	Somewhat Important	Most Important	Somewhat Important	Most Important	Somewhat Important	Most Important	Somewhat Important
Enjoy the lifestyle	20%	60%	67%	33%	NA	NA		50%
Enjoy the work		20%		67%	NA	NA	25%	25%
Primary source of income	60%	40%	33%				50%	25%
Source of additional income		20%				33%		
No other source of employment		20%						
Long-term family tradition				33%				50%
Long-term investment goals	20%	20%	NA	NA	33%	33%		50%
Tax write off			NA	NA		33%		
Cover a portion of fixed costs	20%		NA	NA				
Recreational purposes			NA	NA	33%			
Plan to operate it myself	NA	NA	NA	NA	33%			

Source: Hamilton (1994).

Fulfillment of social obligations may also at times be an important reason for fishing. Fish are an important food item among many of the ethnic groups represented in Hawaii, especially during various social events. Fishermen are expected to provide fish during these occasions and may make a fishing trip especially for that purpose (Glazier 1999).

Finally, some Hawaii fishermen feel a sense of continuity with previous generations of fishermen and want to perpetuate the fishing lifestyle. The aforementioned 1993 survey of participants in the NWHI bottomfish fishery found that half of the respondents who fish in the Hoomalu Zone were motivated to fish by a long-term family tradition (Table 46). This sense of continuity is also reflected in the importance placed on the process of learning about fishing from “old timers” and transmitting that knowledge to the next generation. A recent sociocultural survey of small trolling vessel captains in Hawaii found that many of those interviewed either descend from long-time fishing families or have worked in fishing or fishing-related work since they were in their teens (Glazier 1999). The average captain had almost 18 years of offshore fishing experience. The survey found that 35 percent of boat captains were taught how to fish by their fathers, grandfathers, or uncles, while 32 percent reported being taught by friends (Glazier 1999). Only 14 percent indicated that they taught themselves. Most Hawaii fishermen consider knowledge and experience to be more important factors in determining fishing success than high-tech gear. An example of the value placed on information passed down from previous generations of fishermen is the monument that one town on Oahu has recently proposed to commemorate the kūpuna (elders) of that area who are recognized for their fishing skills and knowledge (Ramirez 2000).

Whatever the motivations for fishing, the contributions of friends and family members to these efforts are often substantial. Small boat fishing in Hawaii is almost always a cooperative venture involving friends or relatives as crew members (Glazier 1999). In addition, wives, in particular, often play an essential role in shore-side activities such as the transport of fish to markets, purchase of ice, vessel maintenance, bookkeeping, and so forth (Glazier 1999).

In Hawaii, during the past several years there have been a number of highly publicized clashes between the owners of large and small fishing boats and between fishermen who are newcomers and those who are established residents (Glazier 1999). The reasons for these conflicts are complex, but the perception that the state’s marine resources are being damaged and depleted by certain groups of fishermen is a central factor. Fish landing statistics support the notion that catch rates in some fisheries are on the decline. Many fishermen have found that fishing is no longer a profitable enterprise and have dropped out of the industry (Glazier 1999). The situation is aggravated by a depressed state economy that has made it more difficult for many fishermen to find the financial resources to support marginal fishing operations.

In some cases, government regulations have helped alleviate competition among fishermen. In 1991, for example, a longline vessel exclusion zone ranging from 50 to 75 nautical miles was established around the MHI to prevent gear conflicts between large longline vessels and small troll and handline boats. However, government regulations have also added to the level of tension and feelings of frustration among fishermen. For instance, many fishermen in Hawaii have adjusted to natural variations in the availability of various types of fish by adopting a multi-species, multi-gear, highly flexible fishing strategy. However, this strategy is increasingly constrained by the implementation of limited access programs in Hawaii's major commercial fisheries (Pooley 1993a).

Despite this highly competitive and divisive environment, fishermen have been able to develop and maintain networks of social relations that foster collaboration and mutual support. For example, fishermen's attempts at organizing to promote their shared interests, whether in the market or lobbying government for changes in policy have generally been fragmented. Nevertheless, some fishermen in Hawaii are represented by a hui or organization, and these voluntary associations often facilitate coordination and cooperation for the mutual benefit of their members. A case in point is the Maui Cooperative Fishermen's Association, which comprises bottomfish fishermen, many of whom are part timers. The Association negotiates product prices with one or more seafood distributors who, in turn, supply local hotels and restaurants with fresh fish.

Glazier (1999) observed that membership in a Hawaii fishing hui can instill a strong feeling of camaraderie and solidarity among fishermen. The cohesion within these organizations constitutes available social capital for both their members and the broader community. For example, fishing clubs often organize or participate in community service projects (Glazier 1999). Examples of more ad hoc forms of cooperation among fishermen are also common. For instance, fishermen may take turns trucking each other's fish from distant landing sites to the central fish auction in Honolulu, thereby reducing transportation costs (Glazier 1999).

Close social relationships also continue to be maintained between some fishermen and fish buyers. For example, small-boat fishermen on Kauai and the Kona side of the island of Hawaii tend to sell their catch directly to local buyers who, in turn, sell it to restaurants or retail markets (Glazier 1999). By sending their fish directly to dealers fishermen not only avoid the commission charged by the auction but also enjoy the price stability over the long-term that comes with an established reciprocal relationship. As Peterson (1973, p. 59) noted, "A fisherman feels that if he is 'good to the dealer' in supplying him with fish that he needs to fill his order, 'the dealer will be good to him' and give him a consistently fair price for his fish."

3.6.2.4 Social Aspects of Fish Distribution and Consumption

Archaeological evidence indicates that seafood was part of the customary diet of the earliest human inhabitants of the Hawaiian Islands (Goto 1986). An early European visitor to Hawaii observed that "there is no animal food which a Sandwich Islander esteems so much as fish" (Bennett 1840, p. 214). Nineteenth century immigrants to Hawaii from Asia also possessed a culture in which fish was an integral part of the diet. Despite the "exorbitant" fish prices that Hawaii residents have often encountered in the markets, the level of consumption of seafood in the islands has historically been very high. One early commentator noted the following:

> In the Honolulu market 2,000,000 pounds of fresh salt water fish valued at $5,000,000 are sold annually. These figures represent a high price for a food that abounds in the waters all around the Islands, yet the people of this community, who are great lovers of the products of the sea, will gratify their tastes even at this expense (Anon 1907).

Today, per capita seafood consumption in Hawaii is still at least twice as high as the national average (Shomura 1987).

Because seafood was such a significant item in the diets of local residents, the fish markets themselves became important institutions in Hawaii society. Dole (1920, p. 20) noted that the fish market located in the busiest section of Honolulu was more than a commercial establishment, it was also “Honolulu’s political center where impromptu mass meetings were held; it was, in a way, a social center also, especially on Saturdays for then business was at its height.” Much of the retailing of fish now occurs through self-service supermarkets, but Honolulu’s fish markets have endured and continue to be centers of social interaction for some island residents.

The fish markets comprise retail units the majority of which are single proprietorship, family-type operations. Close social connections have developed between retailers and consumers, as the success of the dealers is largely a function of their ability to maintain good relations with their customers and maintain a stable clientele (Garrod and Chong 1978). One journalist wrote of the Oahu Market, where fresh fish and produce have been sold for nearly a century, “In the hustle and bustle of daily life in downtown Honolulu, many people are drawn to Oahu Market because of its informal charm and the feeling of family one gets while shopping there” (Chinen 1984).

Early in the last century Bryan (1915) developed a list of the various fish purchased in the Honolulu market by each of Hawaii’s principal nationalities. The ethnic identification of Hawaii’s *kamạaina* (long-time residents) with particular species has continued to the present day. The large variety of fish typically offered in Hawaii’s seafood markets reflects the diversity of ethnic groups in Hawaii and their individual preferences, traditions, holidays, and celebrations.

Many of the immigrant groups that came to Hawaii brought with them cultures in which fish are not only an integral part of the diet but are given symbolic and even transformative connotations. Certain fish communicate messages of solidarity, favor, opulence, and the like or are believed to impart specific desirable traits to the diners (Anderson 1988; Baer-Stein 1999). For example, some types of bottomfish that are red in color have found acceptance within the Japanese community in Hawaii as a substitute for red *tai* (sea bream, *Pagrus major*)—a traditional Japanese symbol of good luck and, therefore, an auspicious fish to be served on festive occasions (Hawaii Division of Aquatic Resources 1979; Shoji 1983). The red color of these fish also symbolizes prosperity and happiness.[12] The December peak in landings of opakapaka, onaga, kalekale, and ehu reflect the demand for them as an important dish in feasts celebrating *Oshogatsu* (Japanese New Year’s), considered the most important cultural celebration for people of Japanese ancestry in Hawaii. Serving these fish is also important during non-seasonal events such as wedding and birthday banquets. For Hawaii residents of Chinese descent, fish or *yu* is an important item during feasts celebrating *Tin nien* (Chinese lunar New Year) and other ritual observances, as it is a homophone for abundance (Choy 1989). Fish also symbolize regeneration

[12] The reason *tai* is regarded as a celebratory fish among Japanese is thought to be due not only to its beauty of form and color but also because *tai* suggests the word *medetai*, meaning auspicious (Shoji 1983).

and freedom because of their rapid ability to propagate as well as their speed and unconfined lifestyle (Baer-Stein 1999). Fish with white, delicately flavored flesh are in particularly high demand by the Chinese community during New Year celebrations and other festive occasions (Peterson 1973).

An insistence on quality, as well as quantity and variety, has also long been a hallmark of Hawaii's seafood markets. For example, the Japanese immigrants to Hawaii came from a society in which fishermen, fish dealers, and even cooks typically handle prized fish with considerable care (Joya 1985). Hawaii seafood consumers continue to demand fresh fish. Both the discriminating tastes of local residents and the symbolic meaning with which some fish are imbued are linked to the importance of fish as gifts from one person or family to another. In Hawaii, various types of high-priced fish such as red snapper are highly regarded as gifts (Peterson 1973). Such sharing and gift giving may play an important role in maintaining social relations, as exemplified by the traditional Japanese obligation to engage in reciprocal exchanges of gifts according to an intricate pattern of established norms and procedures (Ogawa 1973). Those who neglect the obligation to reciprocate risk losing the trust of others and eventually their support.

The sharing of fish among members of the extended family and community is also an early tradition of the indigenous people of Hawaii. The social responsibility to distribute fish and other resources among relatives and friends remains a salient feature of the lives of many Native Hawaiians that is enacted on both a regular basis and during special occasions (Glazier 1999). Among Native Hawaiians, fish is considered a customary food item for social events such as a wedding, communion, school graduation, funeral, or a child's first birthday (baby *luau*; Glazier 1999).

3.6.2.5 Social Significance of Fishing to the Broader Community

Commercial fishing has been part of Hawaii's economy for nearly two centuries. Long-established fishing-related infrastructure in Honolulu such as the fish markets and Kewalo Basin mooring area has helped define the character of the city. Moreover, for some major ethnic groups in Hawaii such as the Japanese and Native Hawaiians, the role that their forebears played in the development of commercial fisheries in the islands remains an important part of their collective memory. In 1999, for example, the Japanese Cultural Center of Honolulu organized an exhibition commemorating the past involvement of Japanese in Hawaii's commercial fishing industry.

Given the historical significance of commercial fishing in Hawaii, it likely that some local residents consider the fishing industry to be important in the cultural identity and heritage of the islands. Individuals who have never fished and do not intend to may nonetheless value the knowledge that others are fishing and that this activity is continuing to contribute to Hawaii's social, cultural, and economic diversity. This existence value may be expressed in various ways. For example, some individuals may engage in vicarious fishing through the consumption of books, magazines, and television programs describing the fishing activities that others are pursuing in the waters around Hawaii.

Just as Hawaii's fishing tradition is an integral part of the islands' heritage and character, the image of Hawaii has become linked with some types of locally caught seafood. Among the fish species that have become closely identified with Hawaii are bottomfish such as ōpakapaka and onaga. The continued availability of these seafoods in Hawaii has important implications for the mainstay of the state economy—tourism. Many Japanese tourists visiting Hawaii want to enjoy the traditional foods and symbols of prosperity of Japan while they vacation in Hawaii, including various types of high-quality fresh fish (Peterson, 1973). Hawaii tourists from the U.S. mainland and other areas where fish is not an integral part of the customary diet typically want to eat seafood because it is perceived as part of the unique experience of a Hawaii vacation. For both Japanese and U.S. mainland tourists, the experience of consuming fish in Hawaii may be enriched if the fish eaten is actually caught in the waters around Hawaii. Suryanata (2000) observed that markets within the state for "grown in Hawaii" products have expanded in the past decade through the proliferation of gourmet restaurants that feature "Pacific Rim" and "Hawaii Regional Cuisine." This marketing strategy eschews traditional symbols constructed by the tourism industry in favor of inciting an appreciation of the social relationships and physical environment that make Hawaii n unique place.

Suryanata (2000) also noted that place-based specialty food can retain its appeal to buyers beyond a vacation period or even attract buyers who have never been to the place in question. Just as a consumption of organic food may signify a commitment to a certain environmental and social values, a consumption of products from Hawaii can symbolize a partial fulfillment of a desire to experience or relive a Hawaii vacation. According to a national seafood marketing publication, the power of this constructed value to influence prospective buyers has not been lost on Hawaii's seafood dealers:

> When it comes to selling seafood the Hawaiians have a distinct advantage. Their product comes with built-in aloha mystique, and while they've emphasized the high quality of the fish taken from their waters, they've also taken full advantage of the aura of exotic Hawaii itself in promotion on the mainland and, now, in Europe (Marris 1992, p. 75).

Local production of food as opposed to a reliance on imports also creates opportunities to foster social connections between consumers and their food producers. As noted above, much of the retailing of fish in Hawaii now occurs through supermarkets, and a large quantity of the seafood sold is imported. However, there still exists in Hawaii personal connections between consumers and the individuals who harvest and retail fish. Such connections may have broad public value. For example, a recent article by agricultural researchers identified proximity as one of the key attributes of a sustainable food system:

> A sustainable food system is one in which "food is grown, harvested, processed, marketed, sold, [and] consumed as close to home as possible." An emphasis on locally grown food, regional trading associations, locally owned processing, local currency, and local control over politics and regulation is found within a proximate system. A proximate food system will have "grocery stores close to home which carry local items with little or no corporately owned products to

compete," and would provide "specialty items that characterize the bioregion" (Kloppenburg et al. 2000, p. 182).

3.6.6.6 Native Hawaiian Community

Executive Order 12898, signed in 1994, requires federal agencies to address the environmental effects, including human health, economic and social effects, of federal actions on minority populations and low-income populations. This section describes environmental justice considerations and supplements the socioeconomic analyses in other sections of the EIS.

As discussed in Section 3.7.1 of the Final Environmental Impact Statement, Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region, May 2005, the individuals who participate in Hawaii's bottomfish fishery and other offshore fisheries make up an ethnically mixed group. A survey by Hamilton and Huffman (1997) of small-boat owners who engage in Hawaii's commercial and recreational fisheries, including the troll, pelagic handline, and bottomfish fisheries, found that the overall distribution of survey participants' ethnicities is similar to that found in Hawaii's statewide population in that the three most common ethnicities are Japanese, part Hawaiian, and Caucasian. Part Hawaiians made up 16 percent of the small-boat owners surveyed.

Vessels used in the NWHI bottomfish fishery were not included in the Hamilton and Huffman (1997) survey, but information on the ethnicity of some participants in this fishery is available from a 1993 survey conducted by Hamilton (1994). This earlier survey of 15 owner–operators and hired captains who participate in the NWHI bottomfish fishery found that 87 percent were Caucasian and 13 percent were part Hawaiian. However, it is likely that the ethnic composition of the deckhands aboard these vessels is much more mixed and reflects the highly diverse ethnic character of the state's total population.

With regard to the income levels of small-boat owners in Hawaii, Hamilton and Huffman (1997) reported that the mean household incomes of the survey respondents are above the state average, although the income levels of full-time fishermen tend to be less than those of recreational fishermen. Information on the household income of participants in the NWHI bottomfish fishery is unavailable.

The public scoping process for the FEIS as well as this DSEIS identified people of Hawaiian ancestry as being both a minority population and a low-income population with a particular interest in the use of the marine resources in Hawaii, including the bottomfish resources. These interests arise from complex historical and contemporary economic, social, cultural, and political circumstances that are discussed below. Given the significance of these special circumstances, impacts on the Native Hawaiian community were made a separate impact topic in the Environmental Consequences section of this document.

At present, people of Native Hawaiian ancestry make up about 21 percent of Hawaii's population (Department of Business, Economic Development and Tourism 1999). By most statistical measures, they have the lowest incomes and poorest health of any ethnic group in the state. Native Hawaiians have long been among the most economically disadvantaged ethnic or racial group in Hawaii in terms of standard of living, degree of unemployment, dependence on transfer payments, and limited alternative employment opportunities. In recent years, Native Hawaiians have had the highest proportion of individuals living below the poverty line. In 1989, 6 percent of all the families in the state had incomes classified below the federal poverty level (Office of Hawaiian Affairs 1998). During the same period, 14 percent of Native Hawaiians lived below the poverty line. Nearly 15 percent of Native Hawaiian households receive public assistance income, compared with 6.8 percent of households in the State (Office of Hawaiian Affairs 1998). In several residential areas, more than one third of Native Hawaiian households receive public assistance.

For centuries, Native Hawaiians relied on seafood as their principal source of protein. However, the availability of many traditional seafoods has been significantly diminished. Over exploitation and ecological degradation of inshore areas by pollution have had a pronounced negative impact on Native Hawaiian marine subsistence practices. Shomura (1987), for instance, noted that between 1900 and 1986, the harvest of coastal fish species in Hawaii declined by 80 percent, and catches of neritic-pelagic species declined by 40 percent. The changes in diet that resulted from loss of access to sea resources have contributed to the poor health of Native Hawaiians. Of all racial groups living in Hawaii, Native Hawaiians are the group with the highest proportion of multiple risk factors leading to illness, disability, and premature death (Look and Braun 1995).

There is abundant historical and archaeological evidence of the social importance of fishing in traditional Hawaiian culture. With specific regard to bottomfish, this significance was of both an economic and ritual nature (Iversen et al. 1990). Bottomfish such as kāhala, ulua, and ʻulaʻula (onaga) are specifically mentioned in traditional prayers used by fishermen, and fishing for these species was associated with religious rites. The cultural significance of bottomfish species to Hawaiian society is also indicated by the growth stage names for ʻōpakapaka, white ulua, kāhala, and the varietal names for ʻulaʻula and uku.

There may continue to be a strong cultural and religious connection between contemporary Native Hawaiians and certain species of bottomfish (Iversen et al. 1990). Some present-day Native Hawaiian consumers of these bottomfish may still associate these fish with traditional beliefs and with their dependence upon the fish for food. Because of the high cost of some bottomfish, they may be frustrated in maintaining such a traditional connection. Industry sources report that Native Hawaiians purchase proportionally less bottomfish than other ethnic groups, possibly because other types of fish cost less, and if Native Hawaiians have less disposable income to spend on fish, they would likely opt to purchase less costly species (Iversen et al. 1990).